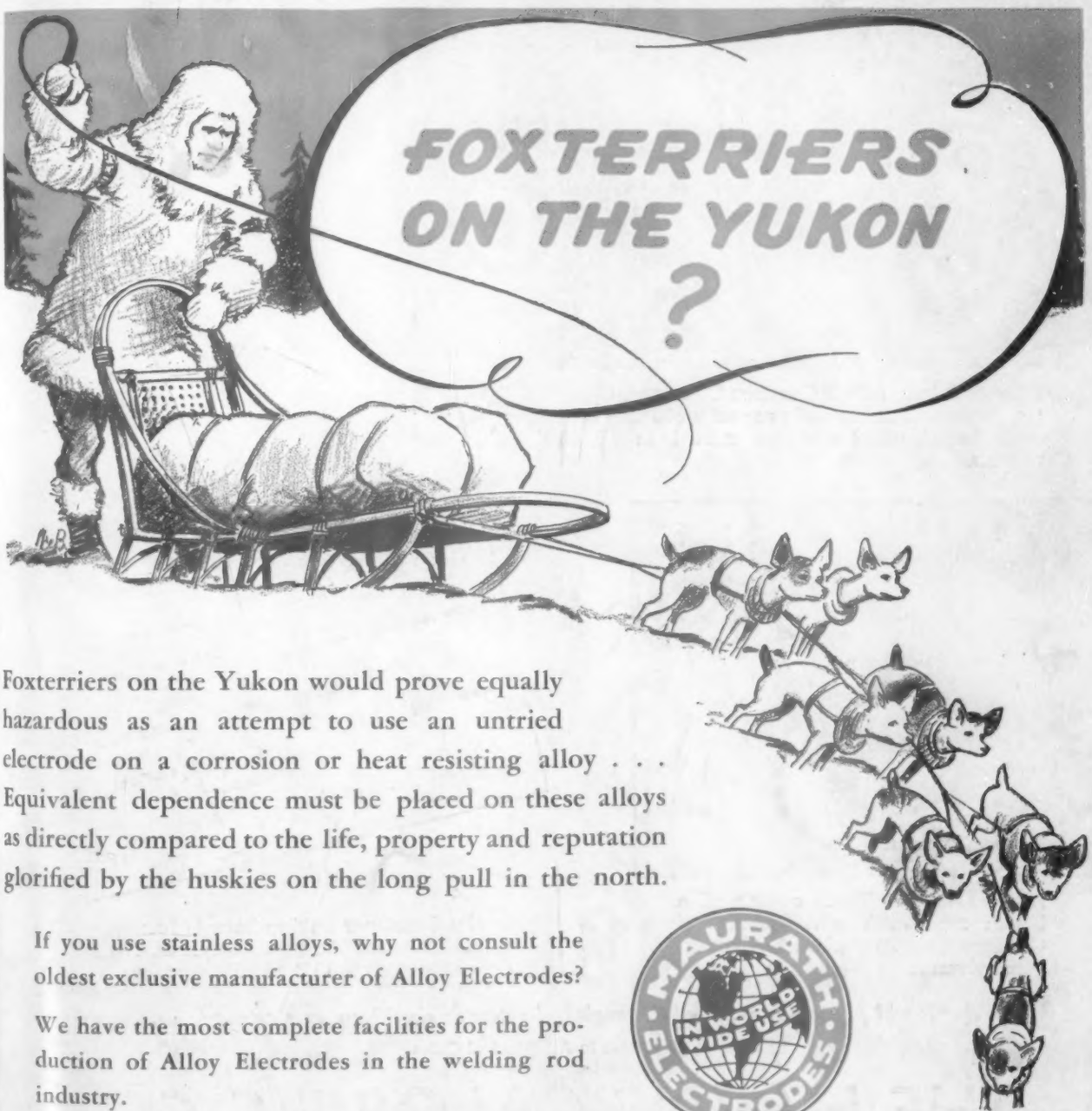
ume 20 SEPTEMBER, 1935 Number 9

The Welding Engineer

Reg. U. S. Pat. Office

Pioneer Business and Technical Journal of the Welding Industry



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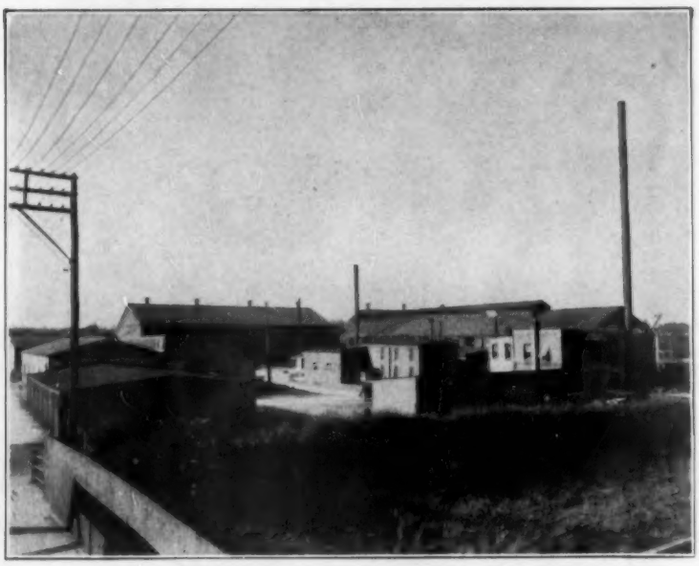

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The Atlantic Steel Castings Company of Chester, Pennsylvania, has adopted Harris City Gas Cutting Equipment. Pertinent facts on their experience are given in the letter reproduced below:

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CHESTER, PENNSYLVANIA

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THE WELDING ENGINEER

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EDITORIAL

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The Big Welding Event of the Year

● For one entire week, Chicago will be the welding center of the world. On September 30th, the doors of the great National Metal Exposition will open, and on the same day the American Welding Society will begin its deliberations with a full program of important papers to be given by widely known authorities in the welding and allied fields.

There will be no papers devoted to welfare legislation or social security. The industrial executives and technicians who assemble will solve such profound problems as unemployment and economic insecurity without even mentioning them. The Cleveland Machine Tool Show, and now the National Metal Exposition, will make improved economic conditions real, and give them some permanence, simply because such shows create desire for changes, for improved methods, for higher-quality products. Such kind of changes spell prosperity.

Social and economic progress would be a slow, tedious climb were it not for the fact that we as a nation take advantage of facilities for the transmission of information. Changes in processes and equipment come about because someone has learned of something better or through the acquirement of knowledge has developed improvements.

The dissemination of knowledge does not belong to any exclusive domain of books, papers and magazines. If one could measure the total sum of knowledge acquired or passed on during the Show and Fall Meeting in Chicago, he would probably be aghast.

Many thousands will be in attendance at the welding exposition and the Fall Meeting, which together form the outstanding welding event of the year. There are many who will pass it by—though they can't afford to. Those who come and make the most of their opportunities will be well rewarded.

★ ★ ★

Long Live the Sky-Ride!

● It was not a holiday throng that viewed the demolition of the remaining tower of the Sky-Ride on August 30th last. The joviality that marked the days of A Century of Progress was absent. It was as though the hundred thousand and more had come to hear a panegyric. They had come to pay their final respects to a structure of steel in which they had found the inspiration of a Shakespeare sonnet or one of the Psalms. After the sound of the great crash had died away, many who had turned to go came back to view a second and final time the thing that they hoped was not true—the Sky-Ride was gone! To some, it was a symbol of man's fortitude in the midst of a depression, the very antithesis of despair; to others it kept alive the pleasant memories of the greatest Fair of all time; and there were those who saw in its huge welded columns and imposing cableway a monument to men of vision.

Like Josiah of old, the Sky-Ride is no more. Long live the Sky-Ride!

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The Welding Engineer

VOLUME 20 SEPTEMBER, 1935 NUMBER 9

Welding Aluminum with the Metallic Arc . . .

■ By ARNOLD MEYER, JR.
Research Department, The Heil Company

UP TO the present time, metallic-arc welding has been applied to aluminum to a very limited extent. Most non-ferrous metals are still joined by some means other than metallic-arc welding. Aluminum metallic-arc welding offers so many advantages, at a considerable saving, that it is deserving of more consideration than it has received in the past. Its use has been more widespread in the last year, this being partly due to the favorable service records of arc-welded structures, but not to any marked improvement in the process.

Some of the advantages of arc welding can be stated as follows:

Heat Stresses Produced by Welding Arc Are Not High

The arc concentrates the heat in such a manner that very little warpage is produced, despite the high coefficient of expansion and the low modulus of elasticity. This low-heat-stress effect is invaluable in welding the low-ductility, hot-short castings and wrought alloys.

In some alloys, heating above a temperature at which a change in phase takes place destroys corrosion-resistance. The heat effect when using arc welding is not great enough to cause any considerable metallurgical change in the structure.

From the standpoint of strength another advantage of arc welding is the high joint efficiency that can be obtained. Most wrought aluminum alloys, and especially the purer aluminum alloys, are strengthened by cold-rolling. The welding heat tends to reduce the strength of the material adjacent to the weld by effecting an anneal on the work-hardened metal. The arc concentrates the heat and the material is not held at the temperature of recrystallization so long as to complete the annealing; also the width of the zone representing annealed metal is quite narrow. All of this increases the joint efficiency, especially on heavier stock.

Tensile Strengths of Some Aluminum Welded Alloys.

Alloy Designation	Average Tensile Strength	Point of Failure	Joint Efficiency
3S½H	17,900 lb. per sq. in.	Adjacent to weld in heat-affected zone	80%
17ST	35,000 lb. per sq. in.	In weld	65%
52S½H	26,400 lb. per sq. in.	At fusion line	80%
53SW	17,900 lb. per sq. in.	In heat-affected zone adjacent to weld	65%

These values are averages taken from standard plate test bars. The 52S alloy appears to be very suitable for applications where welding is required. The fusion-line failure is characteristic of the material whether arc welded or gas welded, and there are many problems concerning the application of 52S which require further study.

The greatest advantage in aluminum arc welding is the low production cost resulting from the high speed obtainable, thus reducing the welding time, saving labor and speeding up production.

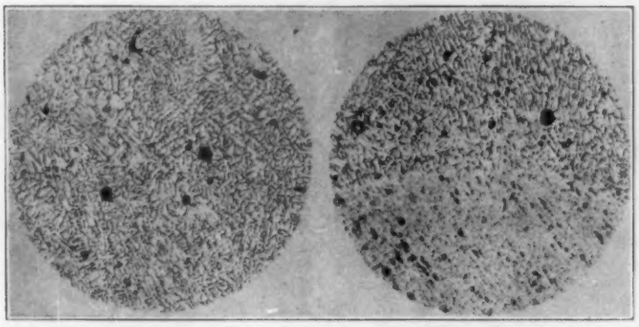
Welding Aluminum Is Not the Same Problem as Welding Steel

When contemplating the use of metallic-arc welding on aluminum, the tremendous differences in the physical properties of aluminum and steel, the metal we are accustomed to welding, should be considered. Iron has a melting point of 2800° F.; aluminum melts at 1200° F. The boiling points are 3200° F. for aluminum and 5600° F. for iron. It appears that the temperatures of vaporization affect arc stability when metallic-arc welding is attempted. The aluminum arc is very unstable; it is very difficult to maintain an arc with a bare wire, and welding with bare electrodes is impossible.

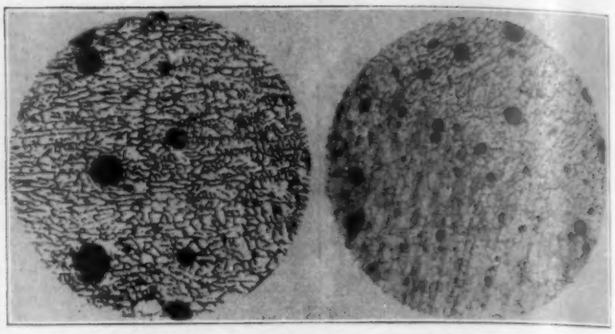
The affinity of aluminum for oxygen and the properties of the oxides are important factors. Aluminum oxide is very stable. It has a higher specific gravity than the melt, and forms instantly, even at room temperatures. Hence, if the oxide is not rapidly fluxed, it will sink into the molten aluminum. Iron oxide is not a refractory substance such as Al_2O_3, but can cause steel weld metal to have poor properties if not accounted for properly. However, shielded electrodes take care of the iron oxide very efficiently. Aluminum electrodes are not as highly developed.

Extruded Coating Would Reduce Porosity and Aid Arc Stability

The fluxes used with aluminum welding to dissolve and eliminate the Al_2O_3 consist of alkaline salts, which will float on molten aluminum, and act as a very



Figs. 1 and 2. Photomicrographs of Satisfactory Weld Metal.



Figs 3 and 4. Photomicrographs of Porous Weld Metal.

(The fusion line is seen in the right-hand micrograph of each pair. Magnification 90X, reduced to 50X in reproduction.)

drastic agent. The electrodes available on the market can stand considerable improvement as far as coating uniformity and degasifying action are concerned. The metal deposited under this flux is very likely to be porous unless precautions are taken to eliminate occluded gases. This is one of the most serious disadvantages of arc-deposited aluminum. Extruding the coating, in its present analysis, will present many problems, but if accomplished, would probably eliminate a large amount of porosity and improve arc stability.

Preheating to remove the "chill" is very effective in reducing porosity. The correct plate-edge preparation, coupled with correct current value and a steady-handed operator, will yield very satisfactory weld metal. Aluminum should be welded with as high a current as possible. Cleanliness and dry electrodes are very necessary prerequisites. The fluxes are all of a hygroscopic nature and must be kept in a dry place or dried before using. The specific gravity of the weld metal varies from 2.68 to 2.45 on satisfactory work. On poor work it goes as low as 2.15 or lower. The photomicrographs show the extent of this porosity. Figs. 1 and 2 show satisfactory weld metal, while Fig. 3 shows weld-metal porosity. Note the porosity in the parent metal adjacent to the fusion line, in Fig. 4.

Presence of Silicon Improves Properties of Weld Metal

The low ductility and low impact resistance of the weld metal cannot be improved much until other alloys are used for filler metal. At present an alloy consisting of 5% silicon and 95% aluminum is used almost entirely, since it has a melting point lower than most of the materials welded and thus it eliminates the tendency of hot-short alloys to crack during cooling. It acts like a feeder in a casting, by compensating for the shrink, and has high-temperature properties that compare favorably with those of the common wrought alloys that are welded.

Recent tests using 52S filler metal on 52S aluminum (a high-strength alloy containing 2.50% magnesium and 0.25% chromium) show greatly improved physical properties in the weld metal as compared to welds made with the 5%-silicon alloy. The tensile strength of the 5%-silicon-alloy weld metal is high enough, but the lack of ductility of the weld metal causes stress concentrations in the weld zone when elastic deformations take place.

The irregular appearance of the beads is due only to a lack of skill on the part of the welding operator. Arc welding is impracticable on gauges below 0.125 in., because the base metal burns away too rapidly and a rough, porous weld is produced. The economic advantages also disappear as the gauge is reduced.

The above shortcomings cannot be too lightly regarded, or disastrous effects may result.

Welded Tank-Truck Bodies Have Proved Satisfactory

The Heil Co. has used arc welding quite extensively on aluminum in the past two years. By combining design suitable for arc welding with careful procedure control, the results have been very satisfactory. A large number of gasoline-tank-truck bodies have been arc welded. These are compartment tanks made of 3/16-in.-thick aluminum sheets of the 3S½H alloy. The tank seams are all arc welded. One of these tanks is shown in Fig. 5.

A number of ¼-in.-aluminum truck bodies for bulk hauling of pulverized cement have been in constant operation for a year without showing signs of failure. These units were completely arc welded. They withstand considerable abuse and provide a good proving ground for metallic-arc-welded aluminum.

Large aluminum milk tanks like those in the train shown in Fig. 6 furnish another test of arc welding. These tanks consist of single compartments containing 2300 gallons. Arc welding has withstood the severe service imposed on it by such equipment without a sign of failure.

The general procedure employed in welding this equipment is as follows:

Joints Are Properly Prepared Before Welding

First, the design of all joints was carefully worked out; single-welded lap joints were eliminated as far as possible, as were all similar points where stress concentrations were likely to occur. It is seldom practicable simply to switch from gas welding to arc welding without considering the design. The alloy was also carefully considered when designing was done.

The plate edges were not prepared in any manner, unless the thickness was greater than ¼ in., and the edges were then beveled. One-quarter-inch-thick material was welded from one side only and in a single pass.

Chill bars were not used, because the sheet had too great a chill property in itself. Back-up strips used were either of steel or asbestos board.

All welding to date has been performed with direct current on reverse polarity. Alternating-current welding on aluminum is being studied at present by our firm. The current values were always kept as close as possible to the top of the range which could be used advantageously. The higher the welding

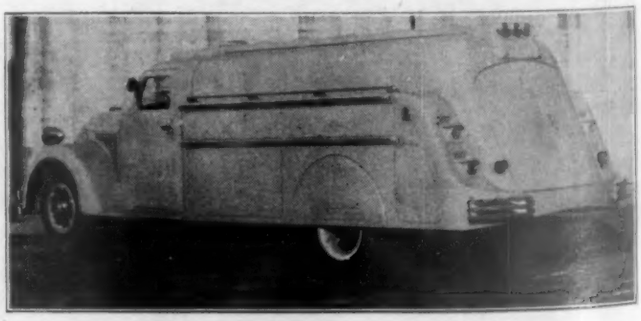


Fig. 5. Gasoline Truck Tank, 1200-Gallon Capacity, of Welded Aluminum.

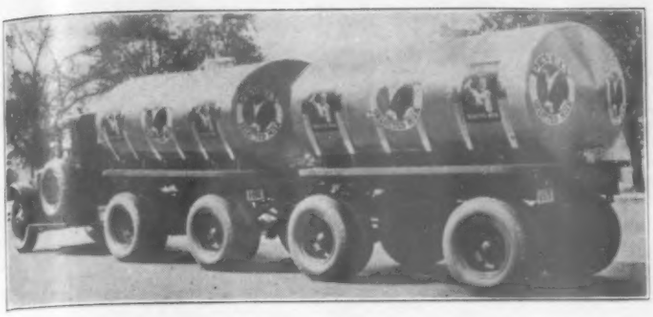


Fig. 6. Milk-Hauling Truck and Trailer Tanks.

current, the lower the porosity will be, other things being equal. The electrode sizes used were the largest that could be manipulated on the plate being welded. A very close arc was maintained, the arc being kept quenched in the molten flux. A long arc produces very poor weld metal and fusion is especially poor.

Initial Weld Puddle Must Be Remelted a Second Time

Stops and starts are a source of trouble unless carefully handled. All metal deposited in the first second was remelted by traveling over it with the arc. If this procedure is not followed, a definite weak spot is produced. The technique used was the same as that employed when starting with a shielded steel electrode.

In tacking work up, the tack welds were made considerably longer than those used on steel or in gas-welding aluminum. All tacking was carefully chipped out because it was always porous, especially at the starting end.

The actual welding progresses rapidly, and a steady-handed operator will produce a bead of excellent appearance after a little practice.

All flux was removed after welding since it has very corrosive properties. If allowed to remain in contact with the aluminum, the flux may cause failure due to corrosion. This is true for both the gas-welding flux and the arc-welding material.

Arc welding of aluminum has been developed to the point where it is very workable, though there remains room for improvements. These improvements will be made much sooner if the process is widely adopted, because this will result in more research effort being expended to further improve the process.

A study of the service records of arc-welded-aluminum transportation equipment is very encouraging, and demonstrates that the arc-welding process has considerable merit at this stage in its development.

Last Sky-Ride Tower Razed by Thermit

The use of thermit mixture played an important part in the wrecking of the east tower of the famous Sky-Ride, the last remaining relic of A Century of Progress. The west tower was demolished several weeks ago, as reported in the July issue of *The Welding Engineer*, it being razed by cutting into the eight cable-holding plates by torches and then blasting the plates in two at their weak sections, causing the cables to pull the tower over toward the east.

Each leg of the tower was made up of three I-beams welded to form an H-section.

Parts of the section of both of the two north legs were cut away by means of an oxyacetylene torch. The strips cut out were 2 ft. high and included part of the web of the web beam, as well as the inside flanges and part of the web of both flange beams. One point of cutting was near the base of the tower, and the other point was 10 ft. higher on the same legs.

Around each of these cut sections was built a mold box for holding a thermit charge of 750 lb. These boxes were held firmly to the column by cables at the top, welded to the box and to the column, and by angles on the bottom, fastened to the column.

This preparation reduced the column section very considerably and also reduced the amount of metal to be fused by the thermit.

Both of the north columns were cut and prepared with thermit molds in this manner, making a total of 3000 lb. of thermit used.

Before setting off the thermit, the diagonal back of each of the north legs was cut through near the column base. Also, the two south columns of the back stay were cut, and 6-ft. sections were cut out of each of the two north columns, thereby preventing the backstay from interfering with the tower falling in the desired northerly direction. Two of the hold-down bolts in each of the south legs were cut off.

Fig. 8. This Photograph Was Snapped a Few Seconds After the Thermit Charges Were Set Off.

Before a crowd estimated at over 100,000 people, the thermit mixture was "flashed" at 3 p.m. on Aug. 30th. In a few seconds, the high heat generated by the thermit had melted the steel at the points holding the molds, the legs at these points immediately collapsed and the tower leaned toward the north and fell amid a cloud of dust, the crashing of steel, and a rumble reminiscent of an approaching thunder storm.

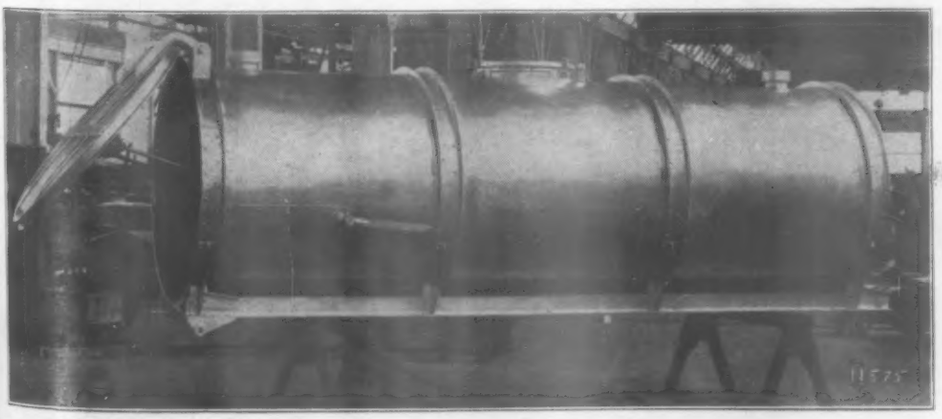


Fig. 7. Welding Was Extensively Used in This Aluminum Body for Bulk Cement.

Welding and Metal Groups to Meet in Chicago . . .

A SYMPOSIUM on methods of minimizing distortion and another one on low-alloy steels for welding purposes—and lecture courses on the heat-treatment of steel and spectographic analysis—are among the special and unusual features to be found on the programs of the American Welding Society and the American Society for Metals, to be given during the National Metal Congress, the week beginning Sept. 30th, at Chicago.

In conjunction with the National Metal Congress is also the huge Exposition, in the International Amphitheatre, at which a great variety of welding and cutting equipment and accessories, as well as other devices of many kinds, will be in operation or on exhibit.

Four National Societies to Cooperate

Besides the American Welding Society and the American Society for Metals, both having headquarters at the Palmer House, other cooperating societies in this congress are the Wire Association, which has selected the Congress Hotel as headquarters, and the American Institute of Mining & Metallurgical Engineers, whose Iron and Steel Division and Institute of Metals Division will hold meetings at the Palmer House.

Registration for the American Welding Society meetings can be made at the Palmer House or at either entrance to the Amphitheatre. There will be no charge for registration and for badges. Reprints of papers will be available at 50 cents a set to members of the Society and at $1.00 to non-members.

The program of the Society begins at 1:45 p. m. on Monday, Sept. 30th. Morning and afternoon sessions will be held on the following three days, with the entire day Friday devoted to inspection trips. All sessions will be in the Red Lacquer Room of the Palmer House. The American Welding Society is joining with the American Society for Metals in a program of entertainment for the ladies, which includes sight-seeing trips to places of interest, and several luncheons.

New Milwaukee Welding Section to Be Honored

In addition to the two symposia mentioned above, another novel feature of the American Welding Society program is a "stag" entertainment at 10 p. m., Wednesday, Oct. 2nd, in honor of the Society's newest section, the Milwaukee Section, whose members will be guests.

The dinner dance at 7 o'clock on Thursday evening, Oct. 3rd, takes the place of the usual annual banquet. Mayor Edward J. Kelly of Chicago will be the dinner guest and will make an address. Special entertainment has also been prepared to make this affair one that will long be remembered.

The inspection trips on Friday will comprise visits to a number of firms that are actively engaged in the use of the welding and cutting processes. Letters are being sent out to several hundred executives of metal-working concerns in the Chicago area, inviting them to participate in these inspections. Provision will be made for luncheon on the trips. Actual applications of the welding and cutting processes in production and repair will be seen and it is likely that at one of the plants the visitors will see a thermit repair being made.

Metallurgists will find considerable of interest in the program of the American Society for Metals, particularly the series of lectures on the heat treatment of steel, to be given by Dr. Marcus A. Grossmann, of the Illinois Steel Co., and the course in spectographic analysis, by Dr. E. J. Martin, of the General Motors Corp. The A. S. M. meetings will be divided between the Palmer House and the International Amphitheatre. On the afternoon of Sept. 30th, in the Amphitheatre, a paper on "Arc Welding of High-Carbon and Alloy Steels," will be given by T. N. Armstrong, of the Norfolk Navy Yard, as a part of the A. S. M. program.

The Exposition in the Amphitheatre will be the largest in five years. More than 225 firms have signed for space, many of these being manufacturers and suppliers of welding and cutting equipment and supplies. All of the 164,000 sq. ft. of the Amphitheatre will be devoted to exhibits and demonstrations. In addition to the welding and cutting displays, many booths will exhibit steels and various alloys, both ferrous and non-ferrous, also grinding equipment, testing machines, magnetic and x-ray testing equipment, and other products of interest to the fabricator.

Many Firms Will Demonstrate Welding and Cutting Processes

Several exhibits will be particularly outstanding. As in the expositions of recent years, the Air Reduction Sales Co. will have on demonstration several types of machine cutting torches, which promises to be one of the high-lights of the show. A new development in torch cutting machines will be shown by the National Cylinder Gas Co. The Bastian-Blessing Co. will demonstrate welding and cutting with the oxy-propane flame.

An arc saw, in which the cutting is done by the arc from a d.c. or a.c. welder, will be demonstrated by the Rich Manufacturing Co. A demonstration of

The New International Amphitheatre, Where the Largest Metal Exposition in Five Years Will Be Held.

Program of 15th Fall Meeting, American Welding Society, at the Palmer House, Chicago, Sept. 30-Oct. 1

Monday, September 30th

Opening Session

1:45 p. m. Introduction of President of American Welding Society by D. C. Wright, Chairman, Chicago Section.

Welcome address by local official.

Announcement 1936 Nominating Committee, by J. J. Crowe, President.

Presentation of Samuel Wylie Miller Memorial Medal, by F. T. Llewellyn, Chairman, Board of Trustees.

Technical Session

2:30 p. m. Presiding Officer—J. J. Crowe, President.

"Bridge Welding—A Review of the Literature," by F. H. Frankland, Vice-Chairman, Committee to Study Welding of Highway and Railroad Bridges.

"Nitrogen in Metallic Arc Weld Metal," by Dr. J. W. Miller, Reid-Avery Co.

6:30 p. m. Dinner Meeting, Board of Directors, Palmer House.

Tuesday, October 1st

Technical Session

9:45 a. m. Presiding Officer—H. T. Heald, Dean of Engineering, Armour Institute of Technology.

Fundamental Research in Welding

"Spot Welding Problems," by J. H. Zimmerman, Massachusetts Institute of Technology.

"Bend Testing of Welds—A Summary," by M. F. Sayre, Union College.

"Advantages of Welding in Continuous Structures," by Inge Lyse, Fritz Engineering Laboratory, Lehigh University.

Technical Session

2:00 p. m. Presiding Officer—C. A. Adams, Director, American Bureau of Welding.

Fundamental Research in Welding

"Arc Welding with Pure Iron," by Gilbert E. Doan, Lehigh University.

"Investigations of Residual Stresses," by R. E. Jamieson, McGill University.

"Tests to Determine the Feasibility of Welding the Steel Frames of Buildings for Complete Continuity," by W. M. Wilson, University of Illinois.

"Creep Tests of Welds," by N. F. Ward, University of California.

7:30 p. m. Palmer House. Conference and Meeting of Fundamental Research Committee, American Bureau of Welding—H. M. Hobart, Chairman, presiding.

This conference is scheduled for the assistance of university research workers in the fundamentals of welding.

Wednesday, October 2nd

Technical Session

9:45 a. m. Presiding Officer—D. C. Wright, Chairman, Chicago Section.

"Fabricated Composite Dies," by K. Janiszewski, President, Superior Steel Products Co.

"Welding All-Metal Radio Tubes," by M. L. Eckman, Thomson-Gibb Electric Welding Co.

"A New General-Purpose Meter for Resistance Welding," by C. Stansbury, Cutler-Hammer, Inc.

Technical Session

2:00 p. m. Presiding Officer—G. T. Horton, President, Chicago Bridge & Iron Works.

Symposium on Methods of Minimizing Distortion

1. Pressure Vessels, by J. T. Phillips, Foster Wheeler Co.
2. Repair Welding, by Geo. Hettrick, President, Anchor Welding Service, Inc.
3. Light-Gauge Steel, by J. H. Blaha, General Household Utilities Co.

"Machine Torch Cutting and Fabrication of Tool Equipment," by P. H. Danly, Danly Machine Specialties Co.

Milwaukee Night

10:00 p. m. "Stag Affair"—Entertainment, Sandwiches and Beer—$1.00 per person. Dining Room No. 14, Palmer House.

Thursday, October 3rd

Technical Session

9:45 a. m. Presiding Officer—Dr. W. M. Mitchell, Illinois Steel Co.

Symposium on Low Alloy Steels for Welding Purposes

"The Development and Use of Low Alloy High Tensile Steels in Welded Construction," by A. E. Gibson, The Wellman Engineering Co.

"Welding of Alloy Steels," by H. L. Miller, Republic Steel Corp.; J. C. Holmberg, Struthers-Wells-Titusville Corp.; and E. C. Chapman, Hedges-Walsh-Weidner Co.

Technical Session

2:00 p. m. Presiding Officer—E. Vom Steeg, Chairman, Meeting & Papers Committee.

"Welding of Alloy Steels," by J. C. Hodge, The Babcock & Wilcox Co.

"Effect of Generator Characteristics on the Weld," by J. H. Blankenbuehler, Westinghouse Electric & Manufacturing Co.

"Electrical Characteristics of the Welding Arc," by S. C. Osborne, Wilson Welder & Metals Co., Inc.

"Resistance Welding of Copper Alloys," by I. T. Hook, American Brass Co.

7:00 p. m. Dinner Dance with entertainment. Red Lacquer Room, Palmer House. Tickets $4.00 per person.

Friday, October 4th

Inspection Trips

Unusual arrangements have been made by the Chicago Section to provide first-hand demonstrations to executives of the metal working industry of the varied applications of welding and its general acceptance as a production tool.

The entire day will be given over to these inspection trips. Two routes of inspection will be provided covering various plants in the south and southwestern parts of the city. Individuals registering will be provided optional choice of either route. Provision will be made for luncheon. The following plants will be among those visited:

International Harvester Co. (Tractor Works)
John Mohr & Sons
Illinois Steel Co. (South Works)

Welding Exposition

New International Amphitheatre, Chicago, Ill.

Exposition opens at noon, Monday, Sept. 30th.

Throughout week, Exposition will be open every day from noon to 10:00 p. m., except Thursday, when it closes at 6:00 p. m.

Programs and information available at Registration Headquarters.

Ladies' Entertainment

The ladies will have a get-together luncheon Monday noon, will visit the University of Chicago and Museum of Science and Industry on Tuesday, on Wednesday the Field Museum, aquarium and planetarium, and on Thursday will have a luncheon, with style show following, at Marshall Field's.

metal spraying will be given by the Metalizing Co. of America.

Among the exhibitors demonstrating arc welding will be the Air Reduction Sales Co., The American Brass Co., American Steel & Wire Co., Harnischfeger Corp., Hobart Bros. Co., Hollup Corp., K. O. Lee & Son Co., The Lincoln electric Co., Metal & Thermit Corp., National Cylinder Gas Co., Una Welding, Inc., and Westinghouse Electric & Manufacturing Co.

The following descriptions apply to those exhibits or demonstrations of equipment used in welding and cutting and related fields, as reported by the various exhibitors:

Air Reduction Sales Co., New York, N. Y. Booths E-23, E-19, F-20 and F-16.

Exhibiting (in operation): Various styles in oxyacetylene cutting machines, also portable motor propelled hand guided machine, will be in operation. A machine for cutting off and beveling pipe will also be in operation. A portable tensile and bend testing machine for testing welds will be demonstrated. Other demonstrations will include arc welding, brazing of bronze and brass pipe fittings, hard-surfacing, and welding and cutting. A complete line of welding and cutting equipment and accessories will be on display. A new type Wilson welder will be shown.

In attendance: C. D'W. Gibson. W. H. Ludington, J. F. Pyror, E. F. Pettigrew, H. W. Reade, H. L. Rogers, F. E. Rogers, R. F. Helmkamp, M. M. Weist, J. P. Burns, J. E. Campbell, R. F. McNutt, J. N. Harkins, J. F. Callahan, J. B. Adams, Jr., W. Whaley, J. F. Franzen, W. T. Love, A. J. Vrooman, R. C. Holcomb, T. B. Hasler, F. S. Stewart, P. M. Mattern, H. Schemm, W. Brainard, and E. Walters.

The American Brass Co., Waterbury, Conn. Booth B-2.

Exhibiting (in operation): Oxyacetylene welding with Tobin Bronze rods, and "high voltage" arc welding on copper, brass and bronze, using Anaconda Phosphor Bronze "D" welding rods. Displays of welded Everdur tanks; cast-iron parts, repair welded with Tobin Bronze, and complete selection of Anaconda welding rods.

In attendance: C. E. Swift, W. C. Swift, H. G. Wallis, M. Brandtberg, and W. H. Dowd.

American Manganese Steel Co., Chicago Heights, Ill. Booth O-27.

Exhibiting: Heat- and corrosion-resistant castings, manganese-steel castings, manganese-steel welding rod, and hard-surfacing welding rod.

In attendance: W. M. Black, W. G. Hoffman, E. F. Mitchell, E. A. Lerner, E. Cook, H. Avery, J. B. Terbell, E. J. Nist, E. L. Quinn, and W. A. Henderson.

American Steel & Wire Co., (U. S. Steel Corp. Subsidiary). Booth E-16.

Exhibiting (in operation): Welding will be demonstrated and various products, including welding wires, will be on display.

In attendance: D. A. Merriman, H. A. Squibbs, M. W. Floto, J. W. Patterson, E. E. Louis, W. H. Cordes, F. Connell, John Graham, A. J. Hess, E. S. Humphrys, C. J. McGregor, H. B. Maguire, P. B. Gilroy, I. Rosenblum, J. R. Dixon, W. J. Diekmann, P. M. Jones, W. J. Blaser, L. S. Young, and A. E. Ward.

The Bastian-Blessing Co., Chicago. Booth K-34.

Exhibiting (in operation): Gas welding and cutting equipment as used on high-speed production-welding operations. Valuable free prizes will be given for the closest estimate of the number of parts welded each day. Demonstrations of various welding and cutting operations using both oxyacetylene and oxy-propane flames will be made.

In attendance: E. L. Mills, H. A. Goodwin, H. O. T. Ridlon, and E. M. Evleth.

Chicago Eye Shield Co., Chicago. Booth N-4.

Exhibiting: Goggles for welding, chipping and grinding, helmets for welding and babbitting, respirators for dust and chemicals, and a metal toe guard for workmen's shoes will be on display. A sand-blast mask will be demonstrated.

In attendance: Robert Malcolm, Fred Guilbert, and Joe Duffy.

General Electric Co., Schenectady, New York. Booth A-3.

Exhibiting (in operation): Parts used in G-E refrigerators will be brazed in a batch-type controlled atmosphere electric furnace which will be operated on a production basis. Also a variety of electric furnace brazed assemblies will be exhibited.

In attendance: H. F. Scarbro and H. E. Lewis.

General Electric X-Ray Corporation, Chicago. Booth D-32.

Exhibiting: Many actual illustrations of x-ray installations in the various branches of the metal trades will be shown. There will also be an exhibit of films explaining the various uses of x-ray equipment.

In attendance: E. W. Page, R. F. Dent, H. I. Trenary, L. C. Sheldon, and E. E. O'Donnell.

Handy & Harman, New York, N. Y. Booth M-15.

Exhibiting (in operation): Soldering and brazing monel metal, stainless steel, copper and other metals and alloys will be demonstrated using silver solders, Sil-Fos and Easy-Flo.

In attendance: F. T. Van Syckel, A. W. Swift, and Leo Eddelson.

Harnischfeger Corporation, Milwaukee, Wisconsin. Booth D-42.

Exhibiting (in operation): Demonstration of uniform arc characteristics of new 300 ampere welder. New convertible electric motors. R-type hoist for handling work in the welding department.

In attendance: F. Wollaeger, Klaus L. Hansen, C. W. Daniels, and R. Derr.

Haynes-Stellite Company, Kokomo, Indiana. Booth I-1.

Exhibiting: Cutting tools and hard-facing rods.

Hobart Brothers Co., Troy, Ohio. Booth E-7.

Exhibiting (in operation): Arc welders in five sizes ranging from 75 amperes (for welding metal 26 gauge and over) up to 400 amperes (for welding very heavy sections). The display will include many interesting examples of actual welding applications, while an experienced operator will be on hand at all times to demonstrate arc welding on steel, cast iron, aluminum, stainless alloys, manganese steel, and other metals.

In attendance: E. A. Hobart, O. H. Menke, Russell Flora, W. H. Hobart, E. C. Galbreath, W. J. Chaffee, E. K. Butterfield, and R. C. Bercaw.

Hollup Corporation, Chicago. Booth K-3.

Exhibiting (in operation): A.C. and D.C. welding will be demonstrated and also automatic arc welding. A complete line of electrodes will be on display, along with coupons of tests made, on different grades of rod, giving the physical properties of the weld.

In attendance: G. N. Wright, O. L. Howland, A. M. Candy, R. P. Monroe, I. A. Bender, R. A. Davidson, W. D. Gannett, and A. A. Bernard.

International Nickel Company, New York, N. Y. Booths E-2 and D-2.

Exhibiting: Industrial applications of nickel and its alloys will be shown.

In attendance: C. McKnight, R. A. Wheeler, E. J. Bothwell, H. S. Lewis, E. A. Turner, T. H. Wickenden, H. J. French, N. B. Pilling, O. W. McMullan, T. J. Wood, E. J. Hergenroether, D. A. Nemser, O. B. J. Fraser, H. L. Geiger, A. G. Zima, and J. S. Vanick.

The Kelley-Koett Manufacturing Co., Inc., Covington, Ky. Booth F-5.

Exhibiting (in operation): A miniature working model of an x-ray machine capable of penetrating up to 5½ in. of steel. Many photographs and x-ray reproductions will be exhibited.

In attendance: W. S. Werner, D. A. Eddy, G. E. Geise, C. A. Poole, S. W. Hedlund, H. D. Welch, C. W. Ransom, F. W. Geiger, F. H. Fritts, C. L. Sherratt, H. A. Shanafelt, and H. A. Moore.

K. O. Lee & Sons Co., Aberdeen, S. Dak. Booth K-23.

Exhibiting: Two sizes of A.C. welders will be demonstrated. Various types of shop equipment will be on display.

The Lincoln Electric Co., Cleveland, Ohio. Booth H-3.

Exhibiting (in operation): Latest arc welding machines and new-type electrodes. Visitors will see the electric arc in action welding mild steel, high-tensile steel, stainless steel, manganese steel, high-carbon steel, cast iron, aluminum, copper and other metals. Welding of sheet metal as light as 24 gauge will be demonstrated with two new small, motor-generator types of arc welders. Automatic arc welding by the shielded-carbon-arc process with the "Electronic Tornado" system will be demonstrated daily. The use of two new electrodes—"Toolweld" for making cutting edges on machine tools, and "Abrasoweld" for building up straight carbon steel, low-alloy or high-manganese steel surfaces to resist severe abrasion—will be shown. Electrode holders, electrode and motor cable, protective shields and goggles, gloves, leggins, wire brushes and automatic welding supplies will be on display.

In attendance: A. F. Davis, C. M. Taylor, V. Peters, G. E. Tenney, W. R. Horton, H. B. Downing, W. I. Miskoe, L. G. Hinchman, L. W. O'Day, J. C. Ardagh, G. R. Johnson, and C. J. Daniels.

The Linde Air Products Co., New York, N. Y. Booth I-1.

Exhibiting: Welding and cutting apparatus and welding gases.

Magnaflux Corporation, Pittsburgh, Pa. Booth F-19.

Exhibiting (in operation): Equipment and specimens for demonstrating Magnaflux, for testing welds and metal products. Inspection of tools, heat-treated parts, tool steel and high-speed bars, aircraft-engine and automotive parts, springs, etc.

In attendance: A. V. deForest, Chas. A. McCune, C. E. Betz, and F. B. Doane.

Metal & Thermit Corp., New York, N. Y. Booth D-30.

Exhibiting (in operation): Metallic arc welding will be demonstrated. Also on display will be several sample rail welds made by the thermit pressure butt-weld process, now being used for welding rails in main railroad track.

In attendance: John B. Tinnon, C. D. Young, J. H. Deppeler, J. Plaskon, L. J. Fenton, A. Lucas and L. G. Vock.

Metallizing Co. of America, Los Angeles, Calif. Booth N-1.

Exhibiting (in operation): The Metallizing process for the spraying of metals in wire form. Demonstration of equipment in operation, with spraying unit mounted on a lathe, being used in the actual reclaiming of various machine parts, such as spindles, bearings, cranks, etc., through the use of stainless steel, high-carbon steel and low-carbon steel.

In attendance: R. A. Axline, G. S. Lufkin, W. C. Reid, H. D. Binks, T. Lufkin, and W. Fields.

National Cylinder Gas. Co., Chicago, Ill. Booth L-15.

Exhibiting (in operation): Oxyacetylene Corta cutting machine in operation. Also an arc-welding machine, arc-welding rods, gas-welding rods, carbide and portable tensile testing machine will be on exhibit.

In attendance: W. J. Lacey, H. C. Dowson, H. E. Winkelman, J. L. Adank, C. W. Steele, and Henry Booth.

Page Steel & Wire Division, American Chain Co., Inc., Monessen, Pa. Booth E-32.

Exhibiting: Welding wire and electrodes, both carbon steel and stainless steel, together with stainless steel wires and shapes for mechanical purposes, will be on exhibit.

In attendance: W. H. Bleecker, E. J. Flood, W. A. Berner and J. J. Flaherty.

Republic Steel Corporation, Massillon, Ohio. Booths B-3, B-5, C-3, C-5 and D-3.

Exhibiting: Alloy steels, including stainless and heat resistance steels, will be on exhibit. Applications of Republic steels will be shown by means of a miniature farm display, a working model of an oil well drilling rig, and exhibits of many different types of equipment.

In attendance: R. J. Wysor, N. J. Clarke, A. E. Walker, N. W. Foy, L. S. Hamaker, J. N. Schlendorf, M. H. Schmid, G. F. Hess, S. A. Knisely, C. W. Ruth, H. H. Oldham, W. J. Hanna, R. W. Hull, L. J. Simmonds, J. P. Distler, E. K. Conneely, Kenneth Murray, E. C. Smith, M. J. R. Morris, E. R. Johnson, R. S. Archer, H. W. McQuaid, L. N. Kohl, H. W. Miller, A. J. Wilson, V. W. Whitmer and H. A. Grove.

Rich Manufacturing Co., Ltd., Los Angeles, Calif. Booth O-3.

Exhibiting (in operation): An electric arc saw for cutting metals, using current from an a.c. or d.c. welder, will be demonstrated.

In attendance: A. C. Delevanti and Karl Strebel.

Joseph T. Ryerson & Son, Inc., Chicago, Ill. Booth F-12.

Exhibiting: Welding rods, alloy and tool steels, stainless and heat resistance steels, bearing metal, and steel plates and shapes will be on display.

In attendance: A. Y. Sawyer, W. H. Bryant, G. Van Dyke, V. H. Dieterich, and J. A. Leahy.

Glimpses of Down-Town Chicago

Looking north across the Michigan Avenue bridge.

A view from the top of the Board of Trade Building. The prominent building in the foreground is Chicago's newest skyscraper, the Field Building.

Soldier's Field (Chicago's municipal stadium) in the foreground, with the Field Museum of Natural History and Grant Park beyond. Lake Michigan can be seen at the extreme right and in the distance.

Sellstrom Manufacturing Co., Chicago, Ill. Booth N-4-B.

Exhibiting: Helmets, goggles and welding lenses will be on display.

In attendance: G. E. Sellstrom, A. F. Strand, M. L. Armantrout, G. E. Wenstrom and M. C. Carson.

Una Welding, Inc., Cleveland, Ohio. Booth B-31.

Exhibiting (in operation): A full-automatic arc-welding head will be in operation, showing high-speed production welding. Welders for automatic and manual welding, and welding rods of all types, such as shielded-arc rods, high-speed-production rods, general-purpose rods, and rods used for maintenance work, will be exhibited.

In attendance: N. T. Jones, E. W. Kronbach, L. S. Burgett, C. M. Schaub, and J. S. Vogler.

Union Carbide Co., New York, N. Y. Booth I-1.

Exhibiting: Welding and cutting apparatus, ferro-alloys, carbon products, and oxygen and acetylene.

The Welding Engineer Publishing Co., Chicago, Ill. Booth K-19.

Exhibiting: Welding literature.

In attendance: G. H. Mackenzie, L. C. Monroe, T. E. Depew, F. L. Spangler, and J. C. Holcombe.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Booths B-15 and C-16.

Exhibiting: Display will include two new a.c. welders, a 300-ampere d.c. welder, and Phos-Copper brazing alloys.

In attendance: W. W. Reddie, L. D. O'Connell, F. E. Wiebrecht, M. E. Knudsen, K. W. Merrell and W. C. Pearson.

Orders for Welded Barges Keep Pittsburgh Shops Busy

The demand for all-welded coal barges for inland waterways is increasing rapidly, according to prominent steel men in the Pittsburgh district. This was clearly indicated in a recent purchase of five barges from the Dravo Corp., Pittsburgh, Pa., by the Hillman Coal & Transportation Co., also of Pittsburgh. On this particular order, three riveted and two welded barges were specified. A number of studies and engineering tests were made by the Hillman company on their marine ways at Dravosburg, Pa., following delivery, and a representative of *The Welding Engineer* was informed that the welded barges proved more satisfactory.

Among the reasons advanced, favoring welded barges, were the fact that they are much easier to repair, less skilled labor is required, and labor is more easily provided; moreover, it was said that the Hillman interests are able to make their own welding repairs.

The Hillman interests have been doing considerable experimental work at their marine ways, and recently turned out a welded steel mat for a river derrick.

Ten all-welded steel barges are being built by the Dravo Corp. for stock purposes at their Neville Island boat yard, says S. D. Brown, sales manager. These are standard coal barges and are 175 ft. long, 26 ft. wide and 11 ft. deep. On account of the increased demand for coal-carrying barge equipment, the company hopes to have sufficient orders on hand to dispose of the equipment by the time it is completed. The Dravo Corp. is also building a welded tow boat hull for the Campbell Transportation Co., of Pittsburgh.

Representing the largest barge order to be let to river barge yards in more than four years, a contract has been awarded the American Bridge Co., of Pittsburgh, Pa., U. S. Steel Corp. subsidiary, for the construction of 30 steel barges for the Mississippi Valley Barge Line of St. Louis, according to John L. Taylor, Jr., manager of the barge-contracting department of the bridge company. This order will require more than 75 tons of steel plates and shapes. Delivery must be completed by the latter part of next March. The barges are of the double-shell type, with welded inter bottoms, and will be used to carry freight on the Ohio and Mississippi rivers. They are 132 ft. long, 35 ft. wide and 10 ft. deep and will have cargo houses of steel.

An order estimated at $400,000 has been placed with the Midland Barge Co., Midland, Pa., for the construction of 24 steel barges for the Raymond City Coal Co., of Cincinnati, by the Marion Steam Shovel Co., Marion, Ohio. It is one of the largest orders of its kind to be placed in recent years and it will increase the payroll at the Midland company from 250 to 350, according to officials.

During the past six weeks miscellaneous orders for barges to be built in the Pittsburgh district by industrial concerns will require more than 13,000 tons of steel. This is interpreted as a very healthy condition in the steel industry and it is the first time during the depression that such a large tonnage has been released by industrial users. Most of the construction work in recent years has been for the account of the United States government.

Boasts of A. C. Welding With 3-Phase Primaries

A.c. welding need not be limited to single-phase-transformer equipment, states Arland Ussher, of Ussher Inventions (Pty.) Ltd., Johannesburg, South Africa, in the February, 1935, issue of *The Journal of the South African Institute of Welding*, in which he comments on the article on "A. C. vs. D. C. Welding," by R. K. Hopkins, in the Dec., 1934, issue of *The Welding Engineer*.

"For the single operator, one can get a transformer with a 3-phase primary and single-phase secondary winding. In this case, the load is divided between the 3 phases in the proportion of 1:2:1. This ratio cannot be departed from in this type of transformer, in spite of what the salesmen of the transformers are inclined to tell the non-technical purchaser," says Mr. Ussher.

"If several operators are at work from one transformer, the windings can be arranged 3-phase primary to 3-phase secondary, the secondary having the neutral point brought out and connected to earth. One or more welders can then operate through suitable choke coils, between the terminal of each phase and the neutral.

"If it should happen that all the welders are welding with equal currents at the same time, the load on the primary mains will be perfectly balanced. This condition would, of course, never be obtained in practice.

"The worst possible conditions are when only one phase of the secondary side is loaded. The distribution on the primary side will then be the same as for a 3-phase to single-phase transformer, viz., 1:2:1. In practice the load will naturally vary between this worst condition and the theoretically perfect condition of a fully balanced load.

"An open-circuit voltage of 110 is considered to be on the high side. Eighty volts is quite sufficient for welding with all ordinary electrodes. Stainless-steel and other special electrodes may require 110 volts. A good compromise would be to have a transformer with a 90-volt secondary and a tapped primary, having variations of plus and minus 10%."

Supplementing the above information, Mr. Ussher reports by letter as follows:

"With regard to a. c. welding, our firm now finds it thoroughly satisfactory, as we are using only high-quality heavily fluxed electrodes. We have one 50-kva. oil-cooled transformer with a 500-volt, 3-phase primary and an 80-volt, 3-phase secondary, which is also tapped for 100 volts. These voltages are between neutral and each phase.

"We use external iron-cored choke coils in each welding circuit. On welding duty this transformer will easily supply a total current of 800 amperes, and at times it supplies six welders on structural steelwork welding.

"We ran a test with three welders, each using No. 4 gauge electrodes at 240 amperes, and there was no interference whatever, in spite of the fact that one of the welders was instructed to make and break his arc continuously.

"We are so satisfied with this type of plant that we have on order a 100-kva. transformer—primary voltage of 6600 and secondary of 90 volts. The primary will be tapped plus or minus 10%, which will enable us to get between 80 and 100 volts on the secondary. This particular transformer will have a built-in high-tension oil switch with the usual protective gear and also 3 edgewise ammeters on the secondary side, so that the shop foreman will be able to see at a glance just how the welding load is distributed.

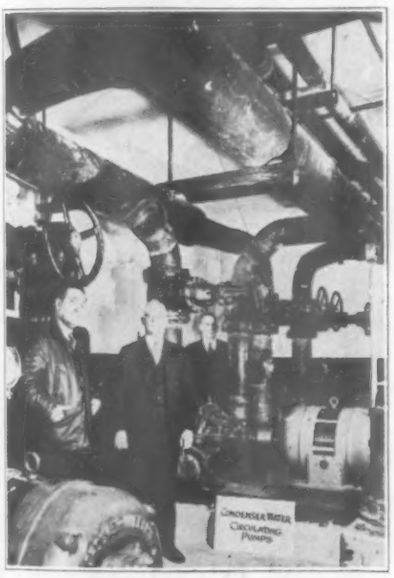
"Electric power here is supplied from the municipal power station and they have not raised any objection to transformer welding plants being installed without condensers. They have complained that our works power factor is on the low side, but they state they do not think it due to the welding plant!"

Welded Piping in an Air-Conditioned Department Store

■ By W. F. BARRON
Air Reduction Sales Co.

WILLIAM FILENE'S SONS CO. in Boston is the first department store in New England to have year-around air-conditioning in its entire building. Each of the eight floors in the main buildings and the separate floors in the several annex buildings have individual automatic control, except for the refrigeration or cooling, which is all done from a central plant in the sub-basement, 40 ft. below street level. This refrigeration is accomplished by a group of Carrier centrifugal refrigerating machines.

The Carrier Corp., Newark, N. J., had the general contract for the entire installation. They sublet the piping contract to the P. McMurray Co., piping contractors of Boston. The sub-contract for the welding was secured by the Star Welding Co. The system is welded throughout.

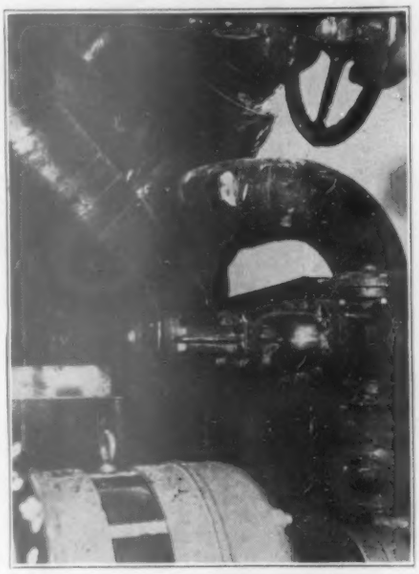


Circulating Lines With Offset Bends.
(The pipelines shown are 14, 12, 10, 8, 6 and 3 in. in diameter.)

In reaching the decision that a welded installation would be far superior to a flanged- or threaded-pipe-joint system, the following factors were taken into consideration:

First, it was found due to the unusual conditions existing in this department store that a welded installation would simplify matters, and would be more economical. Another factor of great importance was the saving in weight that could be realized by the use of welded fittings instead of cast fittings. Still another point was that they found it impossible to secure standard fittings that would give them many of the peculiar angles and bends that were necessary for this particular installation. The use of welded fittings greatly simplified the insulation-covering job. And most important of all was the requirement that the installation be leak-proof. Much of the piping passes through floors and departments where, if leaks occurred, they would prove costly, not only because of damage done to the goods, but in getting at the piping to repair the leaks, inasmuch as a great deal of the installation was enclosed in the walls.

An idea of the extent and complexity of the piping system will be gained from the accompanying photographs and the fact that the 14,000 linear feet



A Tight Nest of Bends Leading From Circulating Pumps in Basement.
(The pipe sizes shown are 12, 10, 8 and 6 in.)

of piping consisted of diameters ranging all the way from ¾ to 14 in., and aggregating 35,000 linear inches of welding, including the welding of Cop-R-Loy pipe, brass pipe, pipe angles, lugs, etc. Gas consumption aggregated 16,000 cu. ft. of oxygen and 14,500 cu. ft. of acetylene, while the welding-rod consumption was between 500 and 600 lb.

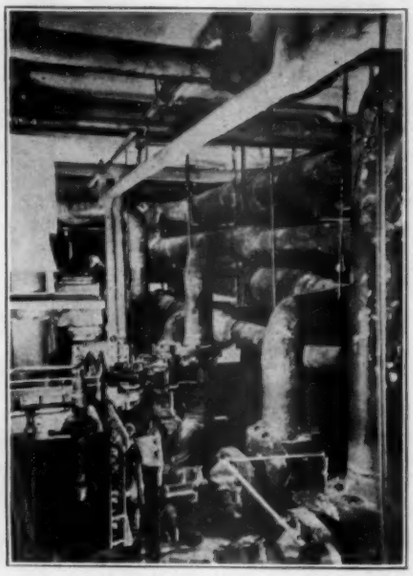
Following are some data taken from an article in the January, 1935, issue of *Fuels and Air-Conditioning:*

"Eighteen million cubic feet of cool,

Welding a 12x8-In. Reducer.
(The illustrations show the tacking of the reducer to the straight pipe section, the welding in progress, and the fitting completed with drip outlet welded.)

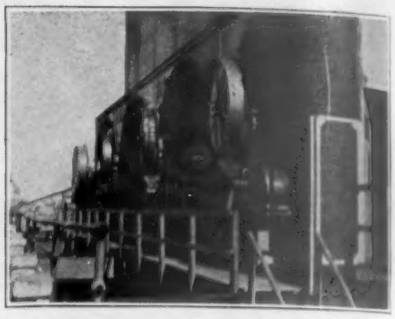
Views of Welded Piping in William Filene's Sons Co. Department Store in Boston

A 10x12-In. Offset and 8-In. Reducer.



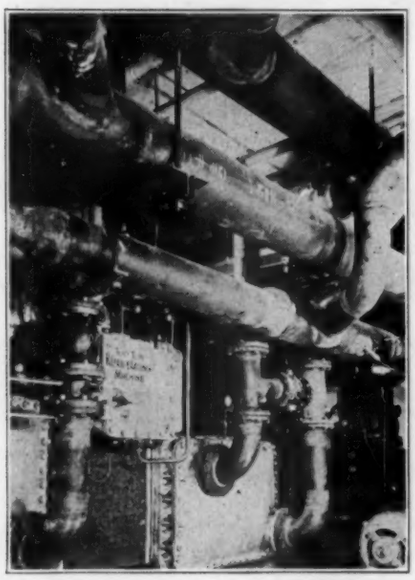
Lines Leading From Ice Machines and From Circulating Pumps.

(The offsets, reducers, double reducers, and welding flange connections were fabricated on the job. "Tube-Turns" are used for bends.)



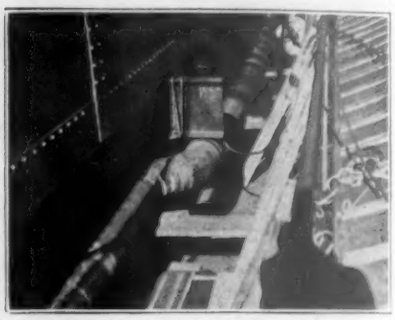
Cooling Units Located on the Roof.

(These four massive cooling units are each capable of cooling 3600 gallons of water per minute. The fans are approximately 8 ft. in diameter.)



Lines Leading From Ice Machines and Circulating Pumps.

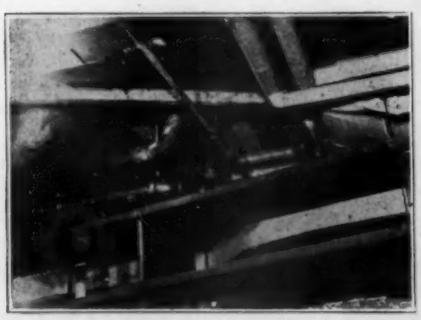
Welding a 14-In. Main.



Offset in Vertical Pipe Leading From Supply Tank and Cooling Towers on Roof.

(The offset reducer shown is 12 in. to 10 in. to 8 in.)

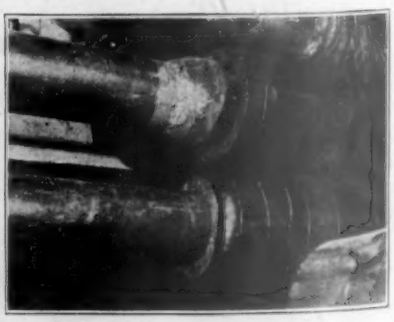
Preparing the Special Cork Pipe Covering.



The Old and the New—Screwed-Joint Line and Welded Line.

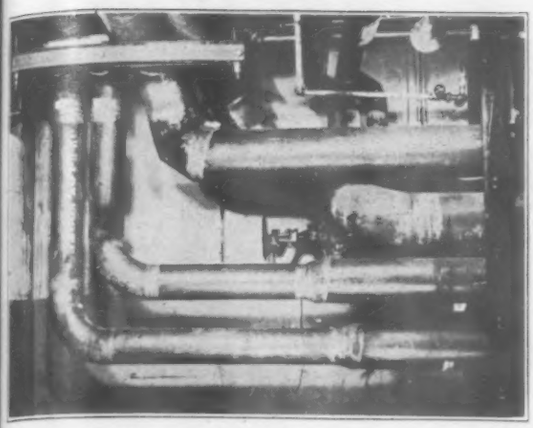
(An old steam line, running through the kitchen, is shown alongside a welded line that is a part of the new air-conditioning system near the seventh floor.)

An Unusual Combination of Reducer Wye and Elbows, 12x10 In.



Part of Covering Applied After Lines Have Been Tested.

(The lines were given a hydrostatic test of 145 lb. per sq. in., and found tight.)



Condenser Lines, With Reducers, Bends and Offsets.

(The unusual offset bend in the upper left center was made possible only by welding. These lines lead to a cooling tower on the roof, nine stories above street level.)

properly humidified or dehumidified air will be delivered through the store every hour. Three changes of air per hour are provided. The changes and quantity of air delivered are based upon an allowance of 10 cu. ft. per person, and are calculated on the basis of 8100 persons in the store at any one time.

"In summer, with the outside temperature at 95° F., the store temperature will be maintained at not to exceed 80°, with 50% relative humidity, from day to day. A humidity of 40% will be maintained in winter.

"The total area of the air-conditioned floor space is 318,000 sq. ft., not including the automatic bargain basement . . . The refrigerating capacity of the new and bargain-basement plants is 1200 tons per day of 24 hours, of which 750 tons is new installation. This equals the work of 10,000 ordinary household refrigerators melting 2,400,000 lb. of ice every 24 hours. Two thousand gallons of cooling water will be circulated every minute.

"Included in the machinery necessary to operate the great air-conditioning system is a cooling tower on the roof, nine stories above the street, 35 ft. high, 60 ft. long, and 30 ft. wide. This will cool the water after it has been circulated over the aerofin coils that cool and clean the air. Four motors operate the fans in the tower."

The photographs herewith give a general idea of the engineering features and crowded conditions, in the basement and sub-basement especially, which made pipe welding a virtual necessity because of space requirements, to say nothing of the leak-proof and trouble-free characteristics of welded joints.

J. F. Lincoln Speaks Up for Present Industrial System

In a vigorous, crisp style, James F. Lincoln, president of The Lincoln Electric Co., Cleveland, Ohio, has written his thoughts on present-day questions and published them in two pamphlets, the first being entitled "Tell the Truth and Keep Out of the Way," and the second, "Ignorance of the Law Is No Defense."

In a preface to the latter, Mr. Lincoln states: "This pamphlet covers the views of an industrialist on the present economic situation. It is an attempt to bring to the notice of the people who must answer the present questions, the point of view of most manufacturing companies. Education sufficiently to inform the voter must be undertaken in some way. If it is not done and the present lack of knowledge continues, the industrial system of this country, which is the most successful in the world's history, is doomed."

The following are some of the choice statements and epigrams found in these two pamphlets:

"Industry didn't happen—it was the result of the genius of a few men. We were ready for it from the time the world began—it had to wait until the proper men were born."

"Executive success requires knowledge of the work, experience, genius and singleness of purpose, no one of which the average office-holder has."

"The theorists in Washington blithely attempt to manage all agriculture, all manufacturing and all labor. This psychology is not new. The maiden aunt is always the one who believes and claims she can tell the mother just how to bring up children."

"We cannot rely upon a government to regulate all industry and agriculture when it cannot regulate the known criminal and bootlegger. We cannot rely upon a government to properly spend a large part of the country's wealth when it cannot keep the veterans from raiding the public treasury."

"American industry can only be held back by fundamental errors. It will not long continue to trail all other industrial countries if given any kind of a chance to function in a friendly atmosphere."

"If an efficient operation in industry is to be obtained, the employer must control. He must direct and hence he must be able to command the cooperation of his employees. If he cannot direct, efficiency disappears, costs are ruinous and the standard of living lowers."

"The mistake made by our brain trust over and over again is that profits are a charge on the consumer. Nothing is further from the truth. Profits of an industry are not a charge but a small part of the savings made to the consumer by the manufacturer who makes the profit."

"It [government] is the most wasteful, clumsiest and slowest form of corporate activity, hence it must be restricted to the few things that can be done in no other way. If we do not so restrict government it will ruin us economically by its waste. It will ruin us morally by its domination and politics. It will ruin our liberties and initiatives by its wish-thinking blundering."

"If government becomes greater than the individual, it is no longer government—it is slavery."

"Any industrialist who is sufficiently wasteful so that no profit is made, is respected and trusted. If, however, he is efficient, pays higher wages and sells his product even at a lower price than unsuccessful competition, but makes a profit, he is an object of attack and destructive tax exploitation from which the waster is entirely free. Governmental inefficiency demands its counterpart in industry."

"If, because of unwise legislation, improper protection, or lack of the needed guiding geniuses, industry should be stopped, our society would come to a cataclysmic end almost immediately. Half the country would starve in thirty days and the rest would be turned into a rabble with blood in their eyes and guns in their hands."

"Government cannot produce—it can only consume. Government cannot develop industry—it can only tax. Government cannot increase activity—it can only pension the incompetent and tax the diligent. Industry only produces. Government can only waste and consume."

"We all work for four months of each year for the government without pay."

"Wealth taken from us by government is gone just as completely and of but little more value than wealth taken by a thug."

"Government cannot reduce prices—it can only increase them. Competition does, has and always will. Government cannot raise quality of product—competition does, has and always will. Government cannot raise real wages—competition does, has and always will."

"We do not scrap our laws because there are still murderers, but we are attempting to scrap our economic system because it has raised real wages by only 500% in a hundred years."

"If the wealth of this country were distributed, 90% would be destroyed by the act of distribution. The resulting starvation and anarchy would destroy the rest in less than thirty days."

Fundamental Data on Resistance Welding . . .

. . . a consideration of speed and cost of welding by the various electric resistance processes, and of recent developments in equipment and control.

■ By A. M. MACFARLAND
Consulting Welding Engineer

THE term "resistance welding" is used to cover all of those welding processes wherein resistance to the passage of an electric current generates localized heat to form a weld. Resistance welding is colloquially known as the "heat-and-squeeze" process, or heat plus pressure properly applied.

The terms "butt welding," "spot welding" and "projection welding" are limited to cover welds made between pieces of metal in actual contact, where no arc is formed, otherwise the process becomes "arc" or "flash" welding.

It is difficult to draw a clear line of demarcation between "spot" and "flash" welding, because in some of the high-speed, or "hot-shot," spot and projection welding the metal at the point of contact is "exploded" or fused and blown away at the instant the current is applied, and a momentary arc is formed.

Understanding of Principles Helps in Set-Up and Operation

A clear understanding of the principles involved in spot welding will help the welder to so adjust his machine, current, points, pressure, etc., as to produce the best results.

If a bar of steel is clamped between two electrodes and a current is allowed to pass, the entire bar will be heated evenly throughout, because the resistance of the bar is uniform. This is the principle of the electric rivet heater.

However, if the bar is in two pieces, with the ends pressed together, the joint offers more resistance to the passage of the current, and extra heat is generated at the joint. Incidentally, a higher voltage is required to force the current through the extra "resistance" at the joint.

The figures given in the table for spot welding are based on the following assumptions:

The metal is carbon steel. The sheets are reasonably clean and flat, and are free from scale. If the metal is scaly or badly rusted, there will be more resistance at the point of contact, and more pressure will be required to make a good contact, and more voltage required to force the current through the increased resistance of the scale or rust; however, if a suitable timing valve is used to regulate the current, this variable is taken care of automatically.

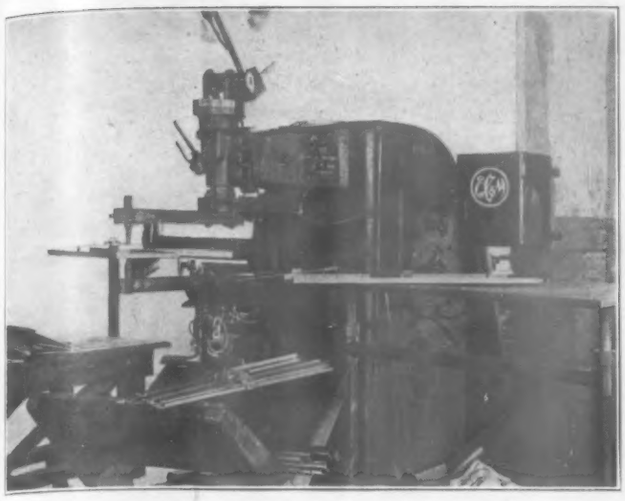
If the material can be sorted, thus obtaining a uniform lot of sheets that are alike in surface condition, the machine can be adjusted to handle it. But if badly scaled sheets are mixed with clean sheets, it is difficult to so adjust the machine as to have all the welds alike. Perhaps they will all "get by," but they will not all be the same. Such mixed work can be handled by a suitable timing valve, without changing the adjustment of the machine.

The spot-welding of chrome steels calls

SPOT WELDING DATA

Gauge	Revolutions or number of Spots per min.	Transformer Capacity, Kva.	Welding Load, Kw.	Kw.-Hr. per 1000 Spots	Pressure, Lb.	*Cost per 1000 Spots at 1c per Kw.-Hr.
26	30	10	3	.03	50	.03
	60	10	6	.03	60	.03
	90	17	9	.03	70	.03
	120	17	12	.03	90	.03
24	30	10	4	.06	60	.06
	60	10	8	.06	70	.06
	90	17	12	.06	100	.06
	120	35	16	.06	120	.06
22	30	10	4.5	.08	70	.08
	60	17	9	.08	90	.08
	90	17	13	.08	110	.08
	120	35	18	.08	130	.08
20	30	10	5	.10	80	.10
	60	17	10	.10	100	.10
	90	25	15	.10	130	.10
	120	35	20	.10	150	.10
18	30	25	6	.16	140	.16
	60	25	12	.16	150	.16
	90	35	18	.16	180	.16
	120	35	24	.16	220	.16
16	30	10	10	.24	175	.24
	60	25	20	.24	200	.24
	90	35	30	.24	250	.24
	120	40	40	.24	275	.24
14	30	25	15	.32	220	.32
	60	35	30	.32	250	.32
	90	60	45	.32	280	.32
	120	60	60	.32	300	.32
12	30	25	20	.48	275	.48
	60	40	40	.48	325	.48
	90	60	60	.48	420	.48
	120	100	80	.48	500	.48
⅛ inch	30	35	30	.63	280	.63
	60	100	60	.63	390	.63
	90	100	90	.63	450	.63
	120	150	120	.63	550	.63
3/16 inch	30	40	20	.87	350	.87
	60	60	30	.87	375	.87
	90	60	40	.87	400	.87
	120	60	50	.87	450	.87
¼ inch	30	60	25	1.6	450	1.6
	60	60	50	1.6	500	1.6
	90	100	75	1.6	550	1.6
	120	100	100	1.6	600	1.6

Based on clean, mild, flat steel, for 26 to 16 gauge, use ⅛-in. tip; for 14 gauge to ¼-in. plate, use ¼-in tip. Throat gap, 12 in.
For scaly stock, increase pressure 50% and kva. 25%.
For each additional 6-in. throat, increase kva. 25%.
*Cost of power for 1000 spots may be determined by multiplying the figure in this column by the cost per kw.-hr.



Spot Welder Equipped With Current-Timing Device.
(Photograph by courtesy of the Electric Controller & Manufacturing Co.)

for a quick, hot shot. The principal requirement is to get it quick enough and hot enough. The pressure should be about 50% greater than for ordinary carbon steel.

Almost any of the commonly used metals and alloys may be successfully spot welded by using the right combination of heat, time and pressure.

Many shops throughout the country have spot-welding machines that are foot-operated, and in which the timing depends largely upon the skill of the operator.

Many of these shops will tell you that spot-welding is not dependable—others, who have learned the uses and limitations of these machines, will tell you that they have no trouble with their welds.

With Today's Machines, There Is No Excuse for Defective Welds

The fact is that there are spot-welding machines available that will do a great variety of welding, and do it day after day, without a single defective weld. It is only necessary for the shop to obtain suitable equipment and to learn how to use it.

One of the most common causes of failure is trying to make a machine of small capacity do work that calls for a machine three or four times larger.

Broadly speaking, the welds become better and more uniform as the current is increased and the welding time speeded up.

An overly long exposure overheats and softens the metal around the weld, and allows time for oxidation. There is slag in the weld instead of good, ductile metal.

A foot-operated machine allows one to extend the time of welding, and will make an occasional weld of heavy stock that will "get by" and serve the purpose, but the quality of such work depends upon the judgment and experience of the operator. A motor-driven machine of larger capacity would do the same work with machine-like accuracy, and guarantee a dependable job, regardless of the weight of the operator's foot.

However, regardless of the kind of machines used, at least one good man is required who knows how to make the original set-up, and see that the points are inspected and kept clean and *kept of the standard diameter,* otherwise bad welds will creep in here and there.

One Has a Choice of Many Timing Valves

There is a great variety of timing valves on the market, and these serve their purpose very well, provided informed judgment is used in their selection.

The simplest form of current-timing mechanism is that fitted to some of the better classes of foot-operated machines. Its operation is based on the idea that when the metal to be welded softens enough to allow the welding points to press into it, it is time to shut off the current. This type of device is operated by the movement of the welding points.

This device serves the purpose of the jobbing shop, covering a large variety of work which requires welds of comparatively long duration, but is not adapted to high-speed "hot-shot" production work.

Then there is also the timing device that is built into the motor-operated machines. In the better class of these machines one will find a timing device that is simple and effective, and adjustable over a wide range. The machines are usually adjustable in speed from 30 to 120 r.p.m., and the timing may be adjusted to correspond. With the machine set at 120 r.p.m., it gives a cycle of 1/120 of a minute, or ½ second. With the timing cam set at the shortest speed, the welding time is, say, 1/10 to 1/20 of a second, or 3 to 6 cycles of a 60-cycle current.

If the machine is in order, and is actually making this time, no advantage is gained from adding a valve to further cut down the time (below 3 cycles) unless the valve is able to split a cycle or can *measure the actual flow* of current rather than the time of contact.

The ordinary timing mechanism of the motor-driven machine makes its contact and holds it for the given period, whether the current flows or not.

With variable resistance in the spots being welded, such as is obtained with 2-, 3- or 4-ply work, it may often happen that the current does not get started to flow with full volume or amperage at the instant of contact. Under such conditions, a valve that will take notice of the current flow, as well as the time, and measure off a shot of uniform *heating value* each time, will be an improvement. Such an integrating valve is used in spot welding automobile-door frames, welding from 2- to 6-ply work without change of adjustment, and making all welds equally good. Several satisfactory varieties of this type of valve are on the market, at prices ranging around $100, more or less.

Timing Mechanisms for Ordinary Service Can Be Had in Five Types

The spot-weld timing mechanism may comprise any one of the following:

(1) Make-and-break contacts on foot-operated machines.

(2) Make-and-break contacts that shut off the current when the weld softens and allows the points to settle.

(3) Cam-operated or -actuated contactor on motor-driven machines, with time-adjustment features.

(4) Various current-breaking devices that cut-out when the current reaches a predetermined peak of flow or amperage.

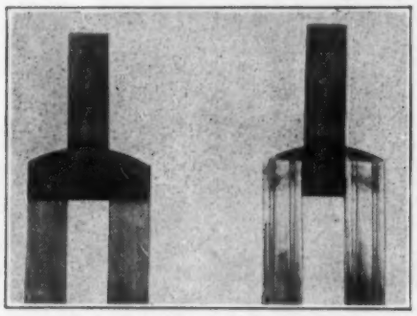
(5) The recently developed type of contactor-operating and -controlling mechanism which measures the total amount of current flowing as regards its heating value. This type operates on the principle of a shunt circuit, loading a condenser, or storing magnetic energy, until a trip device is actuated to shut off the current. It has the advantage of measuring or integrating the current in heating value, rather than time of flow.

The above-listed timing devices operate the usual type of contactor to make and break the circuit and are limited in speed to not less than 3 cycles of a 60-cycle current.

For Quicker "Shots", High-Speed Valves Are Employed

To obtain higher speeds of breakers, it is necessary to employ a device that will cut off the alternating current at any part of the cycle, or at least make and break short sections of current uniformly each shot. These high-speed valves are quite expensive, but they enable the fabricator to make welds that would otherwise be impossible.

The prospective purchaser should make sure that a high-speed cam machine, with a valve of the No. 5 type,



Projection Welds in an Automobile Bumper.

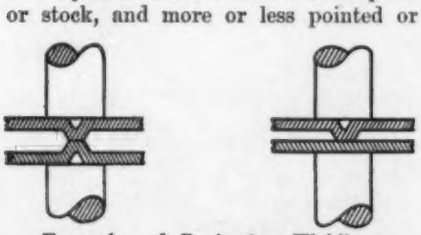
(¼-in. 0.40-carbon steel welded to ⅛-in. 0.18-carbon steel. Not a single defect was found in a lot of 12,000,000 bumpers. Photograph by courtesy of The Federal Machine & Welder Co.)

costing around $100, will not do his work before making a snap decision to order a $700 valve.

Projection Welding Is a Variation of Spot Welding

Projection welding is a modification of ordinary spot welding. A projection or "button" is formed by a punch press or other means where the weld is desired.

The projection is usually of a diameter equal to the thickness of the plate or stock, and more or less pointed or



Examples of Projection Welding.

rounded. The projection may be of the order of 60% of the stock thickness.

Almost any desired number of these projections may be welded at one shot, using flat dies on each side.

The transformer capacity required is about 50% greater per spot than for the same spot on flat work. Some of the machines built for production work, especially in the automobile field, have transformers of 1,800 kva. and employ pressures of 100,000 lb.

It is better to form the projection in the thicker of the two pieces if possible. The projections must all be of the same height so that all will make contact.

Butt Welding Has Long Been Used in Production Work

Butt welding is one of the oldest and most used of the welding processes.

By this process, fine wires or filaments of a few thousandths of an inch in diameter are welded. At the other extreme, there seems to be no definite limit as to the size of bar or plate that can be butt welded.

Among the heavy applications, we find the following shapes being welded: Round steel bars, 8 to 10 in. in diameter; steel plates, 10 ft. long by 16 gauge; plates, 110 in. long by ½ in. thick; and steel pipes of almost any diameter that the customer will pay for.

Machines for welding a range of pipe sizes from 2 to 10 in. in diameter, with ⅜-in. wall, are available in standard designs.

In connection with the heavier butt-welding machines, some general information may be of interest.

There is quite a latitude of choice in the matter of size and cost of a butt-welding machine.

Speed Is an Important Factor in Initial Investment

Speed is quite a deciding factor. A machine of a certain size may be able to weld a given job by allowing it time enough to heat the stock and some time between shots for the transformer to cool. Such a machine would be materially cheaper than one adapted to high-speed production work, and would probably do satisfactory work.

Butt welds on steel stock are being made on a production basis, with welds fully 100% as good as the original stock. There is no blistering, scaling or oxidation at the weld, and the metal characteristics are not changed.

Determining Transformer Capacities for Butt Welding

Generally speaking, about 40 kva. of transformer capacity is required per square inch of cross-section of bar to be welded, of which capacity 75% is working or welding load. This applies to solid bars of the order of 4-, 5- and 6-in. diameters. More power per square inch of section is required for pipe and for pieces of thin section.

For welding pipe having diameters of, say, 4, 5 or 6 in., about 70 kva. capacity per square inch of section will be required. For example, a 6-in. pipe with 9/32-in. wall, having a sectional area of 5⅝ sq. in., requires a transformer capacity of 400 kva. The pressure for welding this 6-in. pipe would be 17 tons, or about 6,000 lb. per sq. in. of section.

As an example of requirements of transformer capacity, an automobile-body welder, handling 18-gauge sheets, 5 ft. long, having a cross-section of

Seam Welding Gasoline Tanks on Automatic Machines.

(The 102-in. seam is welded in 1½ minutes. Photograph by the Ford Motor Co.)

about 3 sq. in., demands a transformer capacity of 125 kva. per sq. in., or a total of 375 kva. About 75% of this capacity is used as welding load, the 25% excess capacity being necessary to prevent voltage drop. The upset or welding pressure would be 7,000 lb. per sq. in., or a total or 21,000 lb.

In considering voltage drop, the fabricator should always make sure that his welding-machine transformer has ample line power behind it. A line transformer of at least 1/3 greater kva. capacity than the welding transformer should be used, and one should make sure that the primary-voltage drop will not exceed 5% on peak load.

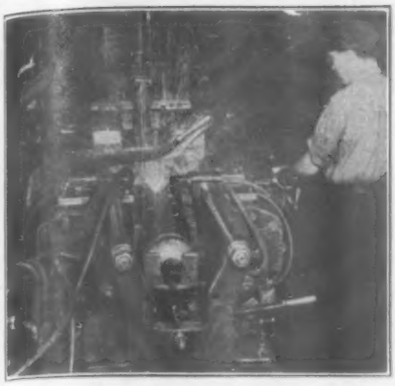
The fabricator, in selecting a butt- or flash-welding machine, will be offered a variety of equipment at a wide range of prices. He should keep in mind that the

BUTT WELDING DATA

(Table by The Taylor-Winfield Corporation.)

Diameter of Stock	Area in Square Inches	Kw. Required	Horse Power	Time per Weld in Sec.	*Cost per 1000 Welds at 1c per Kw.-Hr.	Average No. of Welds per Hour	Labor Cost per 1000 Welds at 30c per Hour
¼ inch	.05	2	3	3	.02	400	.75
5/16 "	.08	3	4	4.5	.05	375	.80
3/8 "	.11	4	5	6	.07	350	.85
7/16 "	.15	5	7	6.5	.10	300	1.00
½ "	.20	6	8	7	.12	250	1.20
9/16 "	.25	7	9	7.5	.15	200	1.50
5/8 "	.31	8	11	8	.18	150	2.00
11/16 "	.37	9	12	9	.23	130	2.30
¾ "	.44	10	13	10	.28	100	3.00
13/16 "	.52	10.5	14	12	.35	95	3.20
⅞ "	.60	11	15	15	.46	90	3.30
15/16 "	.69	11.5	15.5	17	.55	85	3.50
1 "	.79	12	16	18	.60	80	3.70
1 1/16 "	.99	16	21	20	.89	75	4.00
1 ⅛ "	1.23	19	25	25	1.32	70	4.30
1 3/16 "	1.48	25	33	30	2.08	65	4.60
1 ¼ "	1.77	31	41	35	3.00	60	5.00
1 5/16 "	2.07	38	51	37	3.90	55	5.50
1 ⅜ "	2.41	45	60	40	5.00	48	6.20
1 7/16 "	2.76	53	71	43	6.34	40	7.50
2 "	3.14	60	80	45	7.50	30	10.00

*Multiply the prices given above by the rate paid per kw.-hr., to obtain the approximate cost per 1,000 welds for current. When using the flash-welding method less current is required and the figures above can be discounted approximately 50%.



Butt Welding Intake Pipe to Muffler.
(Photograph by the Ford Motor Co.)

large variation in prices represents differences in design, capacity, durability or speed, and that he is not likely to get more than he pays for. For example, a flash-welding machine of the most modern and durable construction may have slides faced with hardened-steel plates, and all bearings with hardened bushings and pins. The dust from the "flash" is highly abrasive and quickly wears out soft bearings.

The control of such a machine may be completely automatic or partly manual.

Automatic Control Removes Hazards of Human Element

The automatic type obviously costs more, but it removes the hazards of the "human element," and assures uniform work. In such a machine, the abutting edges being welded approach each other at a set uniform speed as the surplus metal is burned off; and when the welding temperature is reached, the close-up pressure is automatically applied, removing all control from the operator.

In a modern machine, all the controlling factors are capable of easy adjustment so that the set-up man may easily make his setting for pressure, travel, speed and timing.

There is also a difference in cost and quality of transformers. Some are built as cheap as possible to "get by," and on light loads and service may be perfectly satisfactory and save 50% on the first cost. The difference is in cooling features, cotton or asbestos insulation, laminated or interleaved construction, which affect power factor, efficiency, etc.

The butt welding of non-ferrous metals may be successfully accomplished over a wide range of operations, but each operation presents a separate problem, and the speed, voltage, pressure, etc. must be adapted to the work at hand.

Brass, aluminum and alloy steels are being successfully welded on a production basis. Automatic high-speed attachments for standard butt-welding machines adapted to handle such special work may be obtained from the manufacturers.

Much the Same Equipment Used for Flash as for Butt Welding

So far as the equipment employed is concerned, there is no essential difference between flash and butt welding, but the difference lies in the manipulation of the work to be welded.

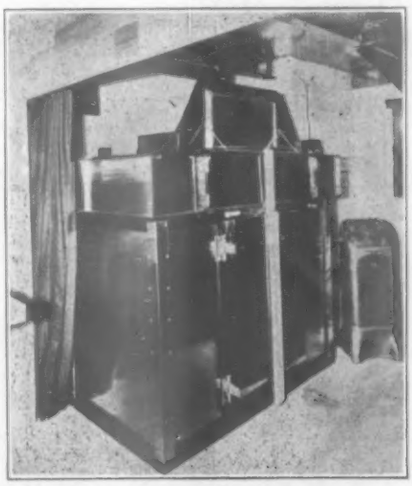
In butt welding, the work is clamped in the machine jaws, with the ends in close contact, and the current is turned on and allowed to flow until the joint has heated to a welding temperature, when a forging pressure is applied and the weld is completed.

In flash welding the same parts, they are clamped the same way, the ends projecting the same distance as for a butt weld. Immediately after the current is turned on, the parts are separated a short distance, causing a sputtering arc, which is allowed to burn off some of the projecting ends. As the ends burn away, they must be moved up to maintain the arc gap at uniform spacing, and this must be done at a steady rate of speed. When the ends are at the welding temperature, they are suddenly closed up by heavy pressure and the current shut off, completing the weld.

High School Uses X-Ray Unit for Instruction

Among the equipment in the new Brooklyn Technical High School, Brooklyn, N. Y., is an x-ray unit for technical training and instruction — the first St. John Educational Unit, installed by the St. John X-Ray Service, 30-20 Thomson Ave., Long Island City, New York.

The equipment consists of a heavy lead-lined cabinet enclosing a standard 200,000-volt x-ray generator and air-cooled tube. Particular attention has been given to design to insure safe operation. The objects to be examined are arranged inside the cabinet, and a removable fluoroscope can be employed for indirect viewing of the x-ray image. The x-rays are permitted to escape from the cabinet only through a single window in the top. Another feature of the installation is a pinhole instrument for high-speed, high-voltage x-ray diffraction analysis of metals.



View of Installation of Educational X-Ray Unit.

The unit is installed in the heat-treatment laboratory of the school, and will be used for checking the crystal structure of metals, for inspecting sand molds and castings, and for inspecting welds. The installation is large enough to take care of the inspection of entire airplane-fuselage structures.

Sand-Blast Machine Built by Welding

The sand-blasting machine shown in the illustration is said to possess longer life, greater capacity and other improvements over the ordinary make of sand blasters, because of its special design and all-welded construction.

Welded Machine Has Capacity of 100 Lb. of Sand.

This machine has an automatic feeding device, by which the machine can be operated through an entire day without stopping. It holds 500 lb. of sand. It was built in accordance with the specifications of the State of California Code for this type of construction. Electric welding was employed throughout.

The improved features and general design of this blasting machine were perfected and patented by the Sandcraft Products Co., of 2019 East 38th St., in Los Angeles, Calif. The machine was built for this concern by the American Steel Pipe & Tank Co., of Alhambra, Calif.

This Modern Hotel has its own Welding Equipment and Crew . . .

■ By L. C. MONROE
The Welding Engineer Publishing Co.

■ Palmer House
Chicago

IT IS said that a modern hotel in a metropolitan center is a city within itself. While no one, at least to the writer's knowledge, has ever tried or contemplates living a life completely within a modern hostelry, the task would not be impossible within the world-famous Palmer House in Chicago. A very full three score and ten years could be enjoyed in this hotel, with its 2340 guest rooms, its six public dining rooms, and a wide variety of shops selling many thousands of articles, ranging from knick-knacks and books to formal outfits and airline accommodations.

As viewed from the welding industry, the Palmer House, to be a city within its own border, would have to boast of a welding shop, because where can one find a city in this country of ours without a job welding shop? Somewhere in every city, welding facilities are offered, and the same is true of the Palmer House, which has its welding shop with both oxyacetylene and arc-welding equipment and an oxyacetylene cutting torch.

The modern Palmer House was built on the site of the original hotel of the same name, which assumed an active part in early Chicago history. The new edifice was opened to the public in 1926. From the very start, oxyacetylene welding and cutting has been a very important cog in the equipment necessary to keep this hotel running.

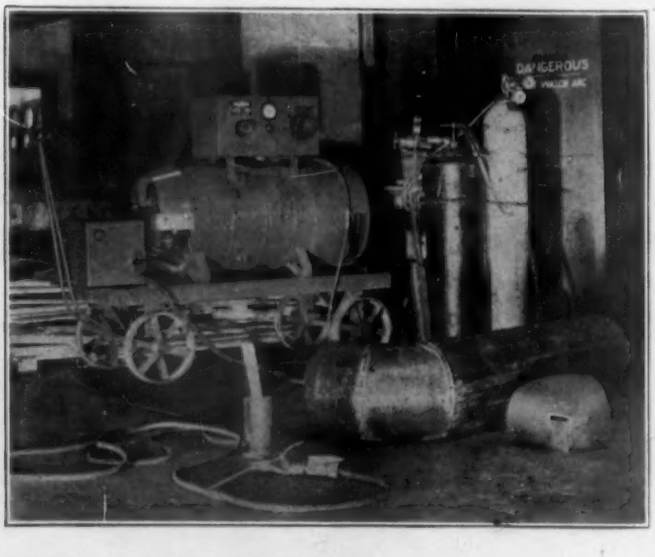
In the early period, a full appreciation of the possibilities and the knowledge which develops confidence was naturally not present, so the process was used sparingly. However, under the expert supervision of J. H. Hill, superintendent, P. H. Mahoney, chief engineer, and E. D. Benton, assistant chief engineer, progress was rapid. It was Mr. Benton who, in addition to his duties as assistant to Mr. Mahoney, was also appointed to be the welder. The record of welding in the hotel is ample proof that Mr. Benton has done his job well. He has dug deep for his knowledge, until today he can talk welding authoritatively with anyone. For many years now, only illness or a breakdown in the hotel has been able to keep him away from any meeting on this subject.

Hotel Maintains Two Welding Shops

The first welding shop was located in the boiler room, which is in the third basement, three floors below the street level. The tanks and equipment were mounted on a truck, and on call could be taken to any part of the building. Now, however, a second shop with its welding table, stock of rods, etc., has been added, which is located in the machine shop in the second basement. In 1934 a d.c. arc-welding unit was added.

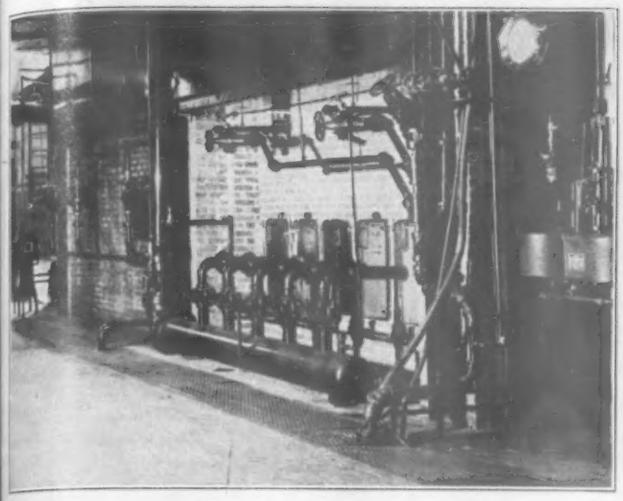
For the first four years, Mr. Benton personally did all the welding. However, time has taken its toll in the form of wear and tear, which is a tremendous item in an immense institution of this kind. The result has been that, with his other duties, Mr. Benton could not handle it all, so now he has one steamfitter and two machinists, who handle the oxy-acetylene welding and cutting, and he does all the electric welding. This has caused a good-natured rivalry between the operators of the two processes, but they recognize that each has its place. To give an idea of the variety of work it might be mentioned that 16 different kinds of rods for welding are kept on hand at all times. This is exclusive of the different sizes in each kind. An other unit added, which has been found very useful, is an air-gas brazing outfit for installing stream-line copper pipe fittings.

"In the earlier stages of welding," says Mr. Benton, "the maintenance crew would always bet on whether a job would hold, but now nothing is ever



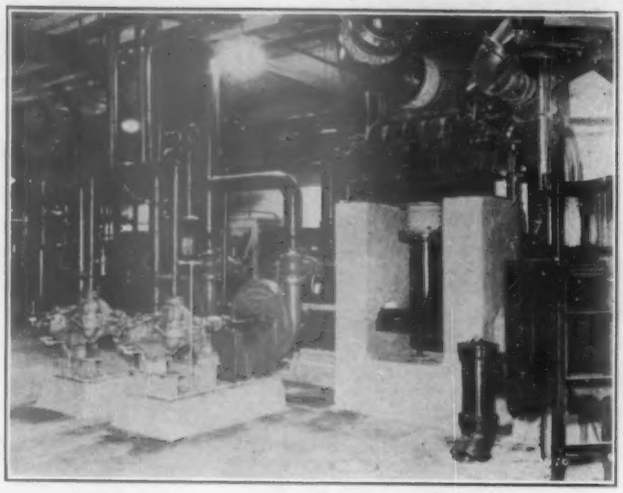
■ A Corner of the Boiler Room, Showing the Welding Equipment.

(In the foreground is a large pipe bend cut out and tacked, ready for welding.)



All-Welded Header on Gas-Fired Boiler.

(This was entirely laid out and are welded in the boiler room, at the time a change-over was made from coal to gas fuel.)



View in Boiler Room Showing Many Examples of Welded Piping.

This Muffler, Fabricated Entirely by Welding, Silences the Steam Jets of the Smoke-Consumer.

(A rough sketch and a few minutes with the cutting and welding torch, and this muffler was the result.)

Fire-Room Tools Fabricated Entirely in the Weldery.

(With a dash of hard-facing applied along the wearing edges, these tools are made to last many times longer.)

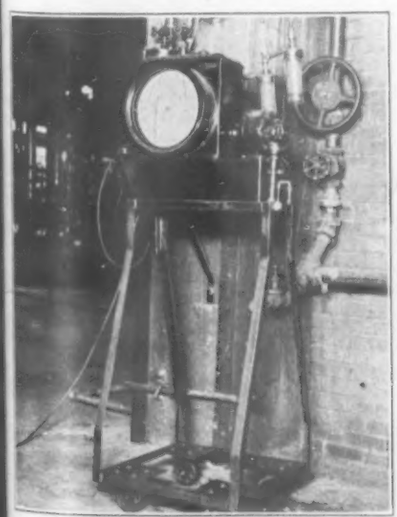
All-Welded Water-Back and Welded Soot-Blower Line.

(The water-back line runs over the rear of the stoker and is subjected to the radiant heat of the furnace and to severe ash corrosion. At one time no welding was allowed on any object close to the fire or on the inside of the furnace, but now welds are used any place where there is metal.)

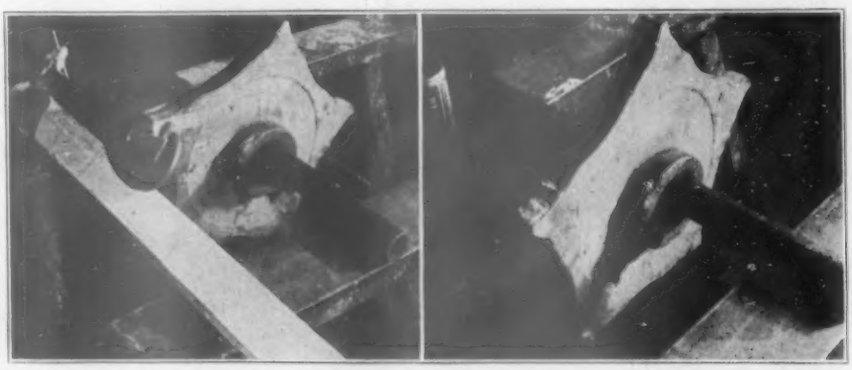
Applications of Welding in the Hotel Boiler Room

Ratchet Dog for Driving a Chain Grate Stoker.

(Left view shows one of the worn driving dogs, center view is of a dog with hard-facing rod applied, and the right view shows the hard-facing material dressed off.)

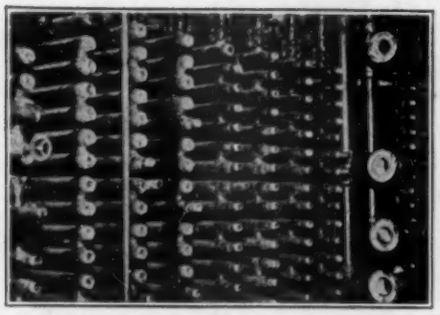


Portable CO_2 Recorder on a Portable Gas-Welded Frame, Fabricated in the Welding Shop.



Hard-Facing Worn Teeth on Drive Sprocket for Chain-Grate Stoker.

(A strip of bus-bar copper is bent around the tooth, as shown in the left view, after which the hard-facing material, of a granular nature, is poured into the mold thus formed and is melted down with the carbon arc. The completed sprocket, shown at the right, lasts indefinitely, while the untreated sprocket lasts only two years.)



Two-Pipe Counterflow CO_2 Condenser, Showing One End Being Repaired by Welding.

(The center tubes are cut out and new tubes welded in. The finished welds must stand a soap-suds test at 1,000 lb. per sq. in. pressure.)

said." This attitude probably is common with all companies in the early stages, but when the process is soundly used, the results are always the same—it gains the full confidence of those who come in contact with it.

The refrigeration requirements of this hotel are met with a total installed capacity of 450 tons—enough to take care of the needs of a city of 10,000 people.

Breakdowns in the Laundry Are Quickly Repaired

The laundry requirements of a modern hotel are necessarily very great. The Palmer House laundry, which is wholly operated by the hotel, but is located at some distance away, has a daily capacity of twenty tons—sufficient to serve a city of many thousand population. All the breakdowns and wear in the laundry are handled by Mr. Benton and his crew of welders. When the work cannot be brought to the hotel, the welding equipment, which is all portable, is taken to the laundry. The laundry must be kept running, because the guests must have clean linen. It is amusing how a man can use the same towel for days at home, but will let out a howl if any hotel clerk puts him in a room with less than four or five towels.

A resume of welding jobs might tell the story better than can be done in any other way. Also it should be valuable information to alert job welders who are close to other hotels that do not have the facilities or the volume to warrant setting up their own weldery.

The jobs illustrated are typical of the kind of work the welding shop is called on to do. Frequently little jobs, but nevertheless important ones, are brought into the shop. For example, a small cast-iron discharge-valve bonnet that had cracked was brazed in only a few minutes, then tested at 1000 lb. per sq. in. pressure, and returned to service.

Refrigerating Equipment Back in Service 11 Hours After Break-Down

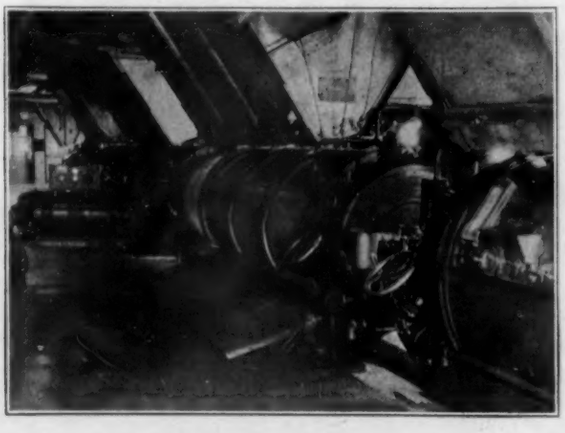
Then there is the case of the breaking of a 1¾-in. exhaust-valve shaft of the Corliss engine driving the refrigerator compressor, which occurred at 9 o'clock one morning. The engine was quickly torn down and the shaft beveled and set up true in a lathe and arc welded. It

Arc Welding the Monel-Metal Pan in a Cascade Washer.

(Fractures developed in the sheets in some of the monel-metal pans, resulting in the tearing of garments. To replace such sheets in the five washers would have required four men working about two months steady. Instead, the welding machine was sent out to the laundry, and in two hours' time the job was completed. The cost of welding compared to replacement of sheets was in the ratio of about 1:300.)

was then allowed to cool, and, without removing it from the lathe, it was machined and put back into service. The loss of this unit cut out 225 tons of refrigeration, which means something on a hot day—and this particular day was hot. What would normally have been a 30-hour shut-down was reduced to 11 hours, and the work was done entirely in the welding shop of the hotel.

Welding here and welding there, so



For Welding in the Laundry, the Arc Welder Is Equipped With an Auxiliary A.C.-Motor Drive.

(The d.c.-to-d.c. generator set, as purchased, is used in the hotel, which is provided with direct current from the power mains. To use the generator in the laundry, which is in a district provided with a.c. power, a temporary extension was built onto the welder frame, and on this was mounted a pump motor of the squirrel-cage type, which was direct-connected to the generator as a driving unit. This view shows the cascade washers in the laundry, with the motor-generator set in the rear.)

Inside View of Part of Head of Hot-Water Heater, Showing Severe Corrosion.

(Approximately 500 to 750 lb. of shielded-arc electrode is required to weld up all pit holes in one of these heaters. Each heater is 7 ft. in diameter and 14 ft. long, and because of its size, replacement would require cutting it into sections for removal, and assembling the new heater by welding in place. Hence, it is more economical to resort to repair than replacement. Note that the rivet heads around the manhole at the bottom of the photograph are welded, which was necessary to prevent leakage. Though these rivet heads were welded ten years ago, which is the length of time this heater has been in service, and bare electrodes were used, the welds themselves are practically free from corrosion, while that portion of each rivet head not covered by the weld is badly eaten away.)

the story goes. Welding sliding-door hangers in the Red Lacquer room, brazing imported French bronze electric fixtures broken by hilarious guests trying to chin themselves, welding miscellaneous jobs for the guests, building an anchor bolt for a 10-ton chain fall—these and many other jobs find their way to the welding department. And then, there are the new garbage cans—these have their bottom edges hard-faced before being placed in service, thereby increasing their service life from 18 months to 8 or 9 years.

Structural changes are frequent in the tenant quarters. A new stairway was needed, which was quickly installed by welding, with no noise to disturb the guests or other tenants.

An outstanding example of savings effected by welding is the repairing by arc welding of monel-metal sheets in the cascade washers in the hotel laundry. One man with an arc welder does a repair job in two hours that it would take four men two months' time to do by any other method.

The use of welding in building up the pitted spots in the hot-water heaters saves the time and expense of replacement. There are six of these heaters, each 7 ft. in diameter and 14 ft. long, and all located in the sub-basement of the hotel. To replace them would require cutting them into sections for removal, and the new heaters would have to be brought in in sections and then welded on the job, instead of being assembled and fabricated in the shop. The repair of one of these heaters requires 500 to 750 lb. of welding electrodes.

The writer asked Mr. Mahoney and Mr. Benton what they would do without welding. Together they answered, "We couldn't operate."

The Banker Takes a New Slant on Credit . . .

By IRA J. OWEN, M.E.
President, Ira J. Owen Organization, Chicago

IN THE past six or seven years, we have witnessed the play of terrific economic forces which have a profound effect on business credit. The situation as regards credit, with which we are confronted today, unquestionably was precipitated by the banking crisis, the memory of which is still with us.

Our friend, the banker, swallowed a bitter pill when he learned the lesson that the balance sheet and the audit sheet are loaded with pitfalls which he had never before suspected. He has learned, much to his disappointment, that the industrial world is not static—that existing technique, processes and practice are being challenged on every hand, the application of basic science is rewriting industrial methods and procedure, and that the only plants to whom money can be lent safely are those with modern equipment and appointments, supported with able management.

Many contacts between bankers and industry have broken down before the loans were consummated, because of a lack of understanding between both sides. The banker has tried to talk to the plant owner in his (the banker's) language, and the industrialist in turn has harbored a misconception of just what the bank wants to know about a borrower before lending him money.

Billions to Lend to Good Risks

Today there are some 15 billions of dollars in excess over legal demands lying fallow in banks. Perhaps you could use some of this money to improve, modernize, expand and extend your business. This might be done at a profit, over and above the cost of borrowing, including a small amount to amortize the borrowings.

What is required of the plant owner who desires to become a borrower?

First, he must know his business so well that he can explain in terms readily grasped by the banker—or by anyone to whom the business may be cold and strange—just what he (the plant owner) is doing, how he does it, and just how often. If he can do that, he has overcome the first obstacle in his path leading to abundant credit. The banker sees more quickly when you use graphics to express your corporate record in business operations. The graphical control system in a business is speedy, and it lends itself nicely to the understanding of all business departments viewed in correlation with one another. In fact, the entire activities of a business for 12 months can be presented on a sheet of paper 30x18 in. in size. Graphic control permits the executive to point out to departmental heads the necessity for teamwork and correlation; it reduces the likelihood of their acquiring the feeling that they are prima donnas and that business is being run just for them, and the departmental heads are made to realize that the benefits of such a system are better wages and more constant employment.

Second, the banker must be convinced by his own investigation that you are exercising constant check and research bearing on your plant operations and administration—not necessarily the kind of research that is built around test tubes and beakers, but research in operation, betterments, in sales presentation, in economy controls and marketing. If metal assemblies enter into the finished product, the banker hopes to find a management that is in tune with welding and other fabricating methods, and knows just what can be expected from these different methods as regards cost and quality of product. He is favorably impressed if the management shows due regard for eye-appeal in the finished product, and if data on markets are being kept up-to-date.

By What Means Can the Loan Be Paid? Asks the Banker

Why do such matters concern the modern banking house? Because the banker is interested in knowing *how* you are going to pay off your loan, and he wants to satisfy himself on this point not after the loan is made but before the papers are signed. When the banker sees that you are administering your business in the way outlined above, he is satisfied that you are not bidding on jobs only to end in losses. The amount of business you will do does not interest him. But he wants to know that you are a good borrower and will live up to your promise to pay, whether secured or unsecured.

There are 125 factors in almost any business that need daily watching, and if any one of these is allowed to run wild, it would wreck the business. Business needs to watch these factors carefully, just as bankers are now doing, and to apply preventive measures rather than to cure the patient after he becomes sick. If you allow your business to run to a point where it is needful to call a curative counsel, it may be too late. Experience has taught the banker that management operating on the preventive school of thought is the best credit risk.

As an example of the application of preventive and curative measures, we will cite the following: Department "A" record shows a loss at the end of six

SINCE the adoption of welding is resulting in a reduction in costs in many industries, and since the ability and alertness of management are measured in some degree by the attitude taken toward new and improved methods, processes and equipment, especially insofar as such improvements result in lower costs or betterment of product, it follows that management cannot afford to overlook the advantages offered by welding, especially if the results of such management are under scrutiny by bankers for the purpose of negotiating loans. Hence, at least so far as the metal-working and metal-using industries are concerned, there is a connection between welding and credit. Credit is plentiful and cheap to those establishments which, by maintaining an unrelenting research into manufacturing methods, product improvement, and marketing, show that they are good risks. If the anticipated increase in fall and winter business is realized, some industrial firms will be seeking loans to make needed improvements or to increase capacity to meet the demand for their goods. Therefore, it is important that business concerns learn without delay what the banker will expect of them, so they can put their house in order and be ready to supply the required information should they find it desirable to seek credit.—Editor.

months because the equipment has been improperly arranged on the floor of the factory, and dog-trails, double-backing and everything else resulting from poor arrangement contribute to loss in operation. Suppose a day or two had been given to study and planning as to the arrangement of the several machines—a 25% or 30% differential in expenses would be brought about. That is prevention. On the other hand, to relocate machines is a cure.

As another example, let us take a salesman calling repeatedly on a prospect, telling the buyer about the apparatus his company makes, how modern it is, how efficiently it works, but he does not get any order for four months. Here is a case for cure. The preventive method would have been to acquire an intimate understanding of the problem of the prospective customer, determine the value of the machine to the prospect's business, and show the prospect that by virtue of what the machine does it would net him a certain return on his investment. This salesman would, in a true sense, be using a preventive sales attack. He has taken himself out of the class of those to be cured.

There is also the case of a prominent manufacturer of appliances advertising at heavy expense a new article. He failed to say in his copy that only those who have electric current in their homes, or whose homes are wired, would be logical buyers. About 60% of the inquiries from the advertising campaign came from people without wired homes. A cure was needed. The preventive method of writing the copy would have been to point out in the advertisements that "this is a modern appliance, for those whose homes are made modern with electricity."

When management adopts the plan of considering departmental action covering the next six to eight months, it is acting by the preventive method, instead of waiting for eight months to see what went wrong and then determining how to cure it.

This same idea may be applied to commercial borrowings. Do not seek curative loans but seek loans supported by planning—that is, by preventive treatment of business management.

Investment Trusts Now Scrutinize Managements Before Buying Shares

The buying committees in charge of some of the better-managed investment trusts, whose shares are now selling at attractive prices, insist on investigating thoroughly the practices of management before they buy shares in any business. Also, within the past two months, the vice-president in charge of investments of one of the larger insurance companies advised that they were completely changing their methods of determining what to buy, leaving the old statistical school and taking an analytic attitude before purchasing, and in order to get assistance in this way they recently took their bank account to one of the largest banks in New York City. The banks are seeing the need for this sort of investigation, and are preparing themselves to give needed advice to their clients having a bearing on these matters.

In other ways the banker also renders valuable service to deserving clients. Where management has shown itself to be alert, he is quick to refer to them such new developments, new items, or new customers as come to his attention. On the other hand, he hesitates to refer such matters to a business that has just grown up "like Topsy" and doesn't know which way it is going. Many cases are at hand where the banker has been instrumental in securing and putting together two accounts that prove very profitable to each other. Likewise, when the banker is impressed with how helpful and beneficial your business is, he may refer your company to another client who may be in difficulty through using an obsolete method. Hence, there are three who are helped—you, the company in difficulty and the banker.

The Outsider's Viewpoint Is Often Helpful

The successful rules of business may be readily applied to any manufacturing or distribution phase of industrial activity. To become acquainted with these rules requires hard work and diligent study on the part of the management, careful planning and execution, and finally an exact record of results or accomplishments. To assist the management, there is the trained specialist and his staff who are equipped to serve business just as the surgeon serves the patient by removing the cataract from his eye, or the attorney serves his client by giving advice on contracts. These business specialists assist business men to become better managers. Their viewpoint, being that of the outsider, is refreshing, constructive and much needed. Briefly, they represent time-free management to study the problems of your business. Not only is this type of specialist needed by business, but many banks are looking to him for advice and avail themselves of his services for making investigations.

The importance of keeping accurate, clear records cannot be over-emphasized, if you would take advantage of credit opportunities. When you ask the banker for a loan, he will want to know the value of your fixed assets, including plant and equipment. He will want to know how you take care of them and protect them, especially in the event of fire or tornado. He will also want to know that the money he loans you is being spent for the best good of the business, and not being dissipated for some pet idea that has no direct bearing on profits.

Several months ago, a fire destroyed some equipment of a large, well-known business having plants scattered all over the country. The head of the company at first was willing to settle for $40,000, which was the value portrayed by the appraisal. But the appraisal did not show that the equipment in question had been relocated and additional money had been spent in its erection and improvement. A detail man in the organization, who was working on an up-to-date plant account, showing the true value of all equipment, its location, and other information, advised the president not to make a settlement until he inspected his records. Finally, a settlement for over $200,000 was asked, and the insurance company readily agreed.

New Treasury Ruling Makes Necessary Accurate Records

In view of the recent ruling of the United States Treasury, known as 4422, executives will be called upon this winter and the early part of next year by Internal Revenue men to check back into the government's allowable rates of depreciation. The federal government has established a ledger sheet and form that is quite accurate in showing just the way they want to see your records. The banker is interested, because this form will have a bearing on how much taxes your business will be expected to pay on its profits, and Mr. Banker knows that any bill presented by Uncle Sam comes first and must be paid from earnings before he collects his loan.

In the recently modified federal bankruptcy law, the banker has learned another lesson, for many cases have gone under 77-B, and he has had to recognize the fact that businesses cannot be rehabilitated by plans that consider only replacement costs. That success in business rests 90% in the hands of management, is true in many cases, including a certain property that recently was estimated as having a replacement cost of $7,500,000.

The hidden losses in your operations are just so much waste, and if these are very great the banker would look upon a loan to your business as just financial oxygen administered only to keep a sick business alive.

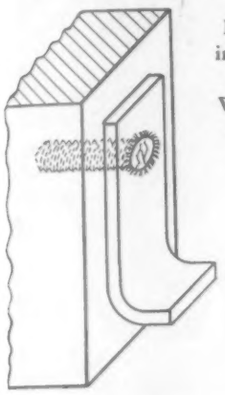
The banker doesn't want dying accounts. He wants long, lasting, durable, growing ones, because he, like you, finds it expensive to get new business.

It behooves every live company to get its house in shape today in order to take advantage of the large volume of business that will soon break on industrial America. There has been a six-year period of little or no expansion, with wearing out of goods, and inaction. Soon replacements and betterments must

come. The better-informed industrial and banking brains anticipate a substantial business activity late this fall or in the winter. It is self-evident who will get the business—the best bidder with a high quality of product. And he is also the one to whom the doors of low-cost credit will be opened.

Broken-Off Studs Are Easily Removed

The diagram illustrates how the Princeton Welding Shop, Princeton, Ill., removes broken-off studs. First, a steel strap is obtained, then a hole drilled in one end of it. After the strap is bent in the shape shown, the drilled end is



Put Drilled Hole in Strap Over Stud, Fill Hole With Weld Metal, Turn Strap, and Stud Comes Out.

placed over the end of the broken stud and weld metal is laid in the hole by the metallic arc. The heat helps to loosen the stud, and with a little oil it can be removed easily upon turning the strap.

Feeding Welding Mask With Oxygen Results in Burns

Because he used compressed oxygen instead of air to feed his mask, a welding operator working in a confined space was severely burned. The accident occurred in a steel shell 11 ft. long and 2 ft. in diameter, completely closed at one end, with an 18-in. opening in the other, through which the operator entered the shell. The electric welding was being carried on at the completely closed end.

"The workman had an oxygen tank connected to his air-line mask," says the *News Letter* of the National Safety Council, in which the accident was reported. "The stream of oxygen that was emitted from the outlet of the mask ignited and caused a serious flare of gas and dust inside the shell. The man was badly burned about the forehead, ears and neck. The management of the plant where the accident occurred insisted he had disobeyed rules in using an oxygen tank instead of air. The promptness of the man's helper, who broke the circuit immediately, probably saved the man's life."

A Welding Engineer's Wife Speaks Her Mind

■ By MILDRED KINKEAD

Marine Department

Cleveland is an important port, and our papers print good ship news. A cold day it is, indeed, when my breakfast is not enlivened by a tale of some steamer in trouble beyond the breakwater, and the water seeping in to damage her cargo of Russian caviar from Riga. I am tense about that ship until the papers report that a welding crew has repaired her plates and put her into shape to reach the harbor.

Getting farther from home, there was that near-launching a few weeks ago at a Lake Superior shipyard. Nice, new coal barge slipping into the water while a band played and the mayor was getting ready to make a speech. Half way down, the barge stuck on the ways and refused to budge. The ceremony stopped and the one shining event in the life of a coal barge was turned into farce. Investigation revealed that some obstruction had ripped the bottom out of the barge and it had to go back into drydock for new underpinnings before it could be launched again.

One thing you learn from following the marine news is that ships have remarkably long lives. Some of the old lake windjammers that sailed before steam, are still afloat. A Cleveland welding contractor, W. B. Boom, often buys up these old ships, for sentiment and salvage.

I don't know why nautical subjects should interest me. Love of ships and sailing adventure is no part of my heritage. My ancestors for generations were determined landlubbers. I never had a relative who could be coaxed into a rowboat anchored in a millpond. Those hardy old salts, my grandparents, spent their lives farming four miles from Lake Erie and never knew what it looked like until somebody sent them a picture postcard. But I'm different. I like ships.

• • •

Tall Corn

As this is written, our northern Ohio is harvesting its 1935 abundance of grain. Wheat, oats, and corn—only the old men can remember the last time these acres gave such fertile yield. But warm, wet growing days this summer have marked nature's return to better disposition.

The countryside, blighted by years of drought, was green this year. Corn grew taller than the tallest man, wheat and oats were topheavy with grain. In some low-lying places nature overplayed her hand, and thankful farmlands freshly rescued from drought were devastated by flood waters. Fine crops, hundreds of acres of them, perished, but surviving harvests are heavy and farm people feel that there is hope again.

In the country it is threshing-time, and sometimes driving along you hear the convulsive clatter of a threshing-machine which you cannot see for the blizzard of chaff. Busy times, for the farmer and his wife also, for it is in her tradition, even with a barbecue at every country crossroads, to feed the harvest hands from her own bountiful kitchen. Threshing-time, the farm woman's yearly crisis, is also the triumph of her womanhood, for it is then that her fried chicken earns its just recognition, her mounds of mashed potatoes vanish in a tide of golden gravy, her succulent vegetables and flaky hot biscuits find their way gratefully into the maws of her ravenous guests. It is good, the woman thinks, to see the mugs of scalding-hot coffee wash down her fabulous blackberry pie, and she flushes in the pleasant glow of male appreciation as the men file out to their work in the fields again.

No matter how much the economists haggle over the financial significance of them, bumper crops make everybody feel good. Rainfall has a lot to do with producing them, and the scientists now have got rainfall hitched to the sunspots. The more spots, the more rain, they believe. From their records they conclude that last year's drought ended a 35-year sunspot cycle, and they go so far as to predict moderately rainy weather for the next 35 years.

Possibly they are right. Fruitful Ohio hopes so!

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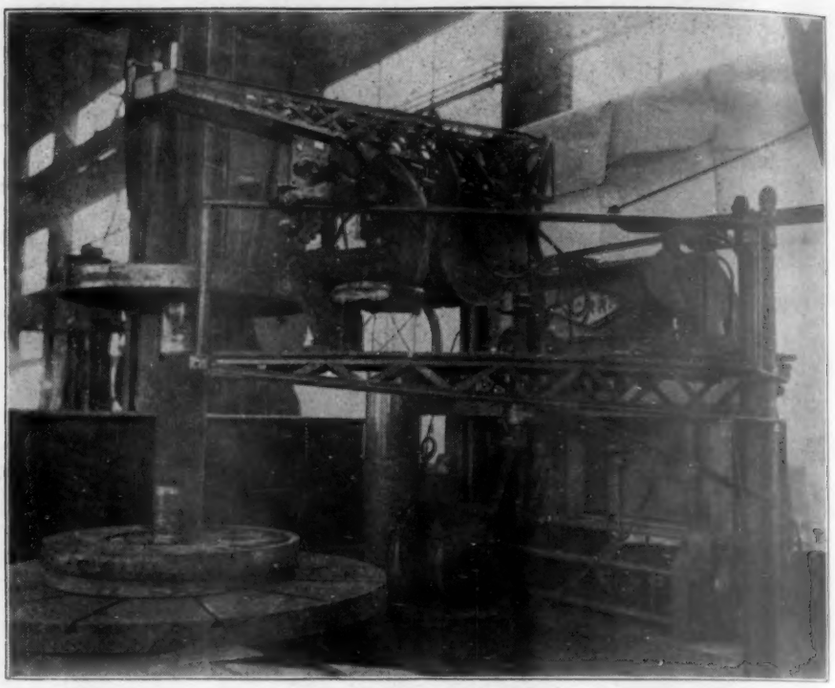
Welder Wanted

Some good welder missed the opportunity of a life-time. If he had been present, and had his equipment with him, he would have "saved the day" for Amelia Earhart at the recent Cleveland National Air Races. Miss Earhart arose to present her trophy cup to Melba Beard, winner of the 25-mile women's pylon race for the Amelia Earhart cup and a $1250 purse. Somehow, in the crush the silver-and-bronze cup had been knocked over and smashed, and Miss Earhart had to apologize for its damaged condition as she made the presentation. A graceful airplane supported by a winged feminine figure had surmounted the cup, but it had been broken off. Miss Earhart assured the winner that the trophy would be repaired and said, "Now, don't you feel bad!"



Building Up Side of Rim of Driving Wheels on 96-In. Boring Mill Equipped With Automatic Welding Head.

Welding Practices in the Modern Railroad Shop . . .

■ By R. R. ROYAL
Master Mechanic, Paducah Shop
Illinois Central System

AMONG the railroads of this country, the Illinois Central is one of the pioneers in the use of welding. This railroad uses the welding processes both in the repair and fabrication of equipment.

For a number of years, d.c. equipment, with bare rod, has been standard at the Paducah (Ky.) shop, but is now being replaced with a.c. equipment employing shielded-arc rod, which rod makes a better weld deposit of finer grain structure and less trouble is experienced from slag and gas inclusions.

Equipment Includes Manual and Automatic Welding Units

Prior to 1930, the Paducah shop had 6 d.c. welding machines, which were used on boiler work, welding small cracks, welding flues in the fire box to the flue sheet, and building up and plugging holes in steel castings. Today this shop has in service 13 d.c. machines and 22 a.c. machines.

In addition to the above-mentioned equipment, we recently installed the following:

Three automatic welding machines and one semi-automatic machine. One of these is reconstructed from a 96-in. boring mill located in the welding department, and one from a 32-in. boring mill.

One 38-in. lathe.

Six gas preheating furnaces and three normalizing furnaces, two of which are pyrometrically controlled. One furnace, with pyrometer control, 6 ft. wide and 17 ft. long, is used for small parts and is heated by three large crude-oil burners. The other furnace is 10 ft. 6 in. wide and 17 ft. 6 in. long, and is used for large parts; it has six burners for artificial gas, which gives a clean, uniform heat.

Oxyacetylene pantograph machine, by which most of the parts for fabrication are cut to shape.

All the above equipment is served by electric and hand cranes to meet individual requirements.

Automatic Welder Reconstructed From Boring Mill

The two sections of the 96-in. boring mill, consisting of a revolving table and frame section, are separated; the front of the frame section is installed 10 ft. from the center of the revolving table. This table, which is 96 in. in diameter, is utilized as the circular base for the work and projects 2 ft. above the floor surface. A boom extends from the back frame section to the circular base, upon which the welding operations are performed. The ram of the boring mill, which is supported by a horizontal rail, is used as a shaft to which the boom is attached, permitting it to swing in a circular path.

The boom may be raised or lowered automatically by raising or lowering the ram. The boom is also counterbalanced on the ram shaft and may be raised or lowered by means of a crane, when set screws that lock the boom to the shaft are loosened. The boom may be moved from one side to another a distance of 10 ft. by the shaft traveling automatically along the ram rail. The boom is 12 ft. long, thus extending past the center of the circular table, and supports the automatic head and all adjusting switches for both welding-machine and machine movements. The switchboard and automatic head are movable on the boom by means of a carriage suspended from small rollers. Two metallic spools of welding wire, from which the electrode holder is fed, are suspended near the attached end of the boom.

The boom may be raised to a height of 12 ft. above the circular base and may also be rotated about the shaft. This makes it possible to place a pair of driving wheels, for building up the side of the rim, in a vertical position without difficulty with the driving axle perpendicular to the table beneath the boom. The boom is so reinforced that practically all vibration and swaying is eliminated, thus making possible a more

constant arc, resulting in better fusion, cleaner welds and a reduction in the amount of welding wire per lineal foot of weld.

Making Straight-Line, Circular and Vertical Welds

All movements of the boom are automatic, being controlled at the pivoted end by a disc regulator for the desired slow movements, with power furnished by a 10-hp., 440-volt motor. The machine may be used for straight-line, circular and vertical welding.

Straight-line welding operations are performed by the automatic horizontal motion of the ram shaft, to which the boom is attached, across the rail of the frame section. The boom travel is 10 ft., thus permitting a 10-ft. length of weld-metal bead to be laid when necessary. The speed, which is determined by the class of work and the size of rod to be used, is regulated by disc control, and may be varied from 1/32 to 26 in. per minute.

Circular movement in either direction is derived from rotation of the circular base, the power being supplied by a 15-hp., 440-volt slip-ring motor. Specially designed gears are used for slow motion. Eight speeds are obtainable, the slowest being one revolution of the table per 30 minutes.

When a part is to be built up, the necessary vertical motion is supplied by an automatic raising or lowering of the ram shaft to which the boom is attached. The speeds of this vertical travel range from 1/32 to 26 in. per minute, and are regulated by the same disc control that determines the horizontal motion.

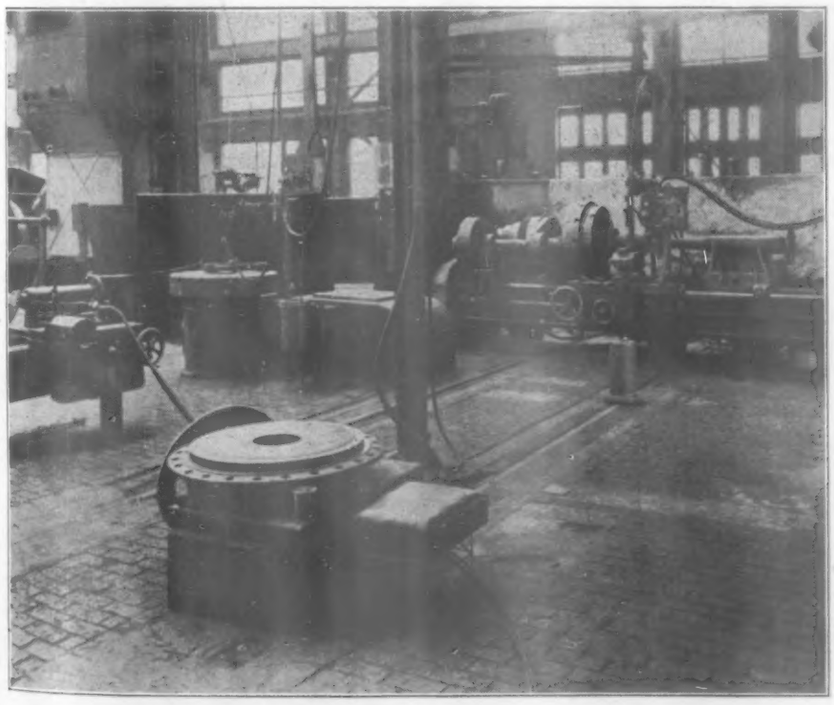
A reinforced cat-walk, 10 ft. long, is pivoted around a cylindrical column 8 in. in diameter located adjacent to the boring-mill frame. It is suitably counterbalanced on the column so that it may be quickly raised to any height up to 10 ft. This cat-walk forms a support for the operator, and from it he is able to make all adjustments and maintain a careful watch during the welding operations. A large spot-light is mounted near the pivot end of the cat-walk to aid the vision of the night operator.

Either alternating or direct current may be successfully used, with bare or coated electrodes. The a.c. machine is a 750-amp., 440-volt-primary, 110-volt-secondary-open-circuit transformer, and is installed from within the back frame section, in order to make the outfit more compact. The d.c. machine is a 400-amp. portable welder.

Electric and Hand Cranes Aid in Handling of Work

A 10-ton electric crane and a 2-ton hand-crane are available for moving material to and from the revolving table. This equipment is used very successfully for handling heavier castings and parts, thereby saving time and lowering the cost of reclamation.

The 32-in. boring-mill table is driven by a 5-hp. d.c. variable-speed motor having sixteen different speeds. Back gears permit the speed to be adjusted to approximately 15 in. per minute for diameters up to 32 in. The boom, pivoted on an adjacent column, supports a carriage from which is suspended the spool of electrode wire, together with the switchboard. The automatic welding head is supported above the table by a suitable bracket. Circular welding and building-up operations on relatively small flat parts are performed by this machine, such as cylinder-head joints, bushings, brake hangers, etc. Welding current is supplied by a 400-amp. d.c. machine.



Inside View of Shop, Showing Some of the Welding Equipment.
(In the rear center is the 32-in. boring mill, equipped with an automatic welding head. The lathe at the right is also provided with an automatic welding head for building-up operations on cylindrical parts.)

Worn Cylindrical Parts Are Built Up on Variable-Speed Lathe

The 36x108-in. lathe also is driven by a 5-hp. d.c. variable-speed motor and is also equipped with back-gearing, which provides 32 different speeds for different sizes of work. An automatic welding head is supported by a bracket on the tool-post carriage, while the switchboard is bracketed to the main carriage. The electrode wire is carried on a spool hung directly over the head on a special rack. This machine is especially adapted for building-up operations on various sizes of cylindrical parts, such as center pins, crankshafts, brake beams, etc., the welding being performed by a 400-amp. d.c. machine.

A semi-automatic welding machine, using a 400-amp. d.c. welder, employs bare electrode. Motion is supplied by manipulation of the electrode holder by the operator. The welding rod is fed to the work from metallic spools.

Jet Cutting Machine Can Handle Plate Thicknesses Up to 22 In.

The oxyacetylene pantograph machine has a table, 4 ft. 6 in. wide and 17 ft. long, upon which the templates are placed, and includes a large channel-iron scaffold which provides space for cutting the materials. An artificial-gas furnace, 4 ft. wide and 17 ft. long, having a portable table, is used to preheat the materials, thus saving fuel gas for cutting. A 2-ton crane on a 75-ft. runway handles material to and from the cutting table. Two torches are mounted for cutting material any thickness up to 12 in., and a special torch is used to cut material up to 22 in. thick. Either tank or line acetylene may be used.

When the parts have been cut to shape by the torch, they are then transferred to the fabrication table. A face plate, 4 ft. 3 in. wide and 8 ft. 6 in. long, with a 2-ton crane to handle the material, makes the fabrication less difficult to handle by the operator. The fabrications are welded with a transformer having a one-hour rating of 500 amp. and a continuous rating of 300 amp., only coated electrodes being used, to insure better welds.

The following parts are reclaimed: driving, trailer, engine-truck and tender boxes, engine-truck center pins, engine-

One-Piece Steel Cylinder Casting Welded to Locomotive Frame.

frame braces and deck plates, guide-yoke cross-ties, steel locomotive cylinders, cylinder heads, cracked or broken locomotive frames, steel rod bushings, valve spiders and spools, valve crossheads, brake beams, brake hangers, stoker-engine crankshafts, stoker troughs, stoker shells, stoker ball joints, stoker-hanger bearings, stoker screws, worn paddles and clevises, driving-wheel centers, etc.

The following parts are frabricated: locomotive pilots, engine cabs, spring saddles, lubricator brackets, cellar end plates, grate straps, housings for portable lift trucks, piston heads, and other parts.

The Illinois Central has adopted a set of rules (see below) that have given unusually good results for the welding of locomotive frames. All frame welding has been done according to these rules for years, and up to the present time no failures have occurred.

High-Strength Joint Between Cylinder Casting and Frame

In connection with this, a very successful method of applying one-piece cast steel cylinders to locomotives has been developed. As the photograph on this page shows, in addition to the butt weld between cylinder casting and frame, there is a long horizontal weld for reinforcement and distribution of stress.

Broken and worn driving-wheel centers are now being repaired by electric welding. Since this method has been adopted, approximately 300 wheel centers have been repaired, and only two of these have failed. One of the failures was a break in the weld and the other a break in the original material adjacent to the weld. The process has been in use for three years.

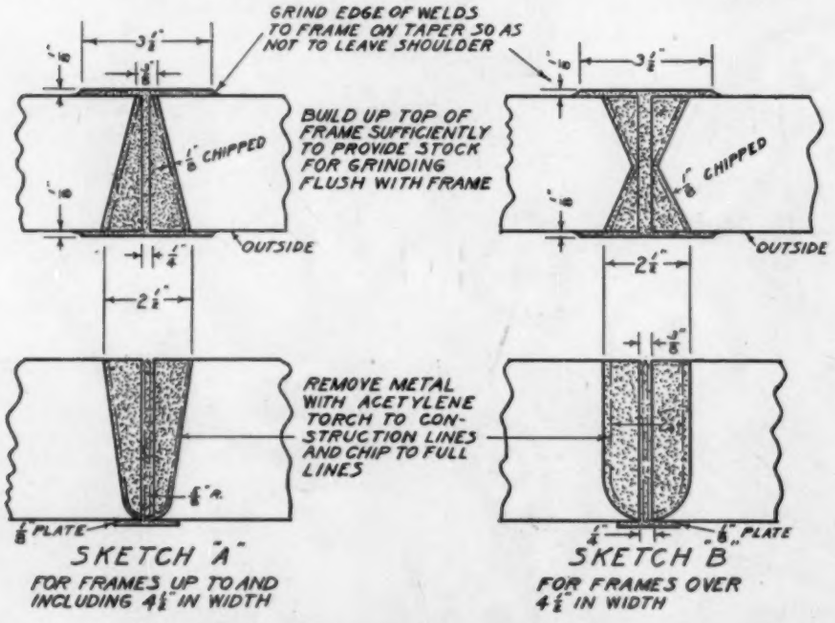
The repair of driving-wheel centers covers the welding of fractures in the spokes, rims and hub, and the building-up of oversize crank-pin holes, oversize

INSTRUCTIONS FOR RECLAIMING LOCOMOTIVE FRAMES

1. Tram frame section in the usual way.

2. Vee the parts to be welded as shown (sketch "A" for frames up to and including 4½ in. in width and sketch "B" for those over 4½ in. in width), cutting with oxyacetylene torch to construction lines and chipping oxidized surface to full lines.

3. Frames should be expanded ⅛ in. during time weld is being made, by the use of wedge, jack or by heating opposite member of frame section.


GRIND EDGE OF WELDS TO FRAME ON TAPER SO AS NOT TO LEAVE SHOULDER
BUILD UP TOP OF FRAME SUFFICIENTLY TO PROVIDE STOCK FOR GRINDING FLUSH WITH FRAME
CHIPPED
OUTSIDE
REMOVE METAL WITH ACETYLENE TORCH TO CONSTRUCTION LINES AND CHIP TO FULL LINES
PLATE
SKETCH "A"
FOR FRAMES UP TO AND INCLUDING 4½" IN WIDTH
SKETCH B
FOR FRAMES OVER 4½" IN WIDTH

4. Reheat with oil torch and charcoal, using netting basket approximately 14x14x16 in. deep, maintaining the temperature during welding between 500° and 800° F.

5. Operators should weld from opposite sides at the same time on frames over 4½ in. in width (sketch "B"). Use ¾- or 5/16-in. shielded-arc electrodes and reverse polarity. Care must be exercised to thoroughly clean by use of chisel, and sand blast each layer of welding beads. Vertical sides of frames to be reinforced to gauge, smooth finish.

6. After welding is completed, normalize as follows: Frames of mild steel—Heat parts welded to 1500° F., with oil torch and allow to cool in charcoal fire. Frame of vanadium cast steel—Heat parts welded to 1550° F. with oil torch; remove charcoal basket and cool in open air below 800° F.; then remove basket and cool in open air; grind weld to smooth finish, all corners radiused ⅛ in.

7. As soon as contraction commences, remove the wedge or jack. Observe the contraction by use of the tram during the cooling process; if it is too great, apply wedge or jack, or heat parts to obtain required length.

8. If possible, welding operation should be continued without interruption until completed.

9. Date of weld, shop at which weld is made, and welder's number must be stamped on frame adjacent to weld where it can be seen, using ⅜ in. stencils.

INSTRUCTIONS FOR RECLAIMING STOKER SCREWS, PADDLES AND CLEVISES

1. All parts must be thoroughly cleaned by sand-blasting.

2. The hubs or shafts are then built up to within ⅛ in. of standard diameter with protected-arc electrodes. When the sockets in the conveyor screws are worn, they are built up with protected-arc electrodes and drifted with a suitable mandrel to standard dimensions. The screws are then cleaned by sand-blasting, and the building up of the hub to standard diameter is completed with the electrode process, using cast-iron welding rod.

3. The screw is then straightened in a lathe, it being heated with a gas torch using city gas and air. If outside diameter of the flights is worn more than ⅛ in. the flights are trimmed off in the lathe with an oxyacetylene torch for the application of ⅛ in. V-strip forged from round spring steel or high-carbon steel; material oxidation of the screw flights is then ground off for the application of V-strip.

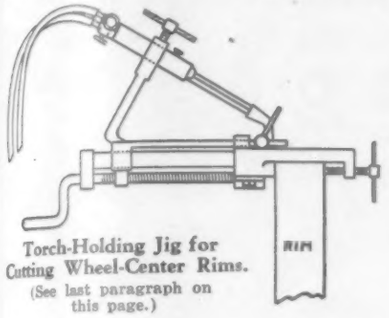
4. The V-strip is applied by heating with a gas torch, using city gas and compressed air, and the strip is spot welded in place while being warped in the lathe. The V-strips are then welded with the electric process, using protected-arc electrodes. When the flights are worn under 1/16 in. of their standard thickness they are built up to within 1/16 in. of standard thickness with protected-arc electrodes, then the screw is thoroughly cleaned by sand-blasting, and wearing sides of the flight built-up with cast iron.

5. After welding has been completed, the screw flights and hubs are ground reasonably smooth. The front horizontal screw flights and hubs are ground perfectly smooth for a distance of 4 in. from the front end of the screw. Positive polarity must be used in applying cast-iron welding rods, using 350 amp.

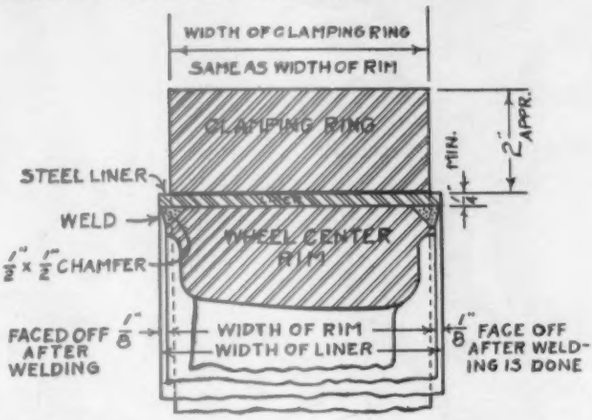
6. Before the outside diameter of the flights is ground to size, the screw is stress-relieved in an oil furnace at a temperature of 1200° F. and held two hours, then left in the furnace until cooled. By this method, the life of the screws is doubled and an estimated saving of 40% made over the purchase of new screws.

METHOD OF RECLAIMING DRIVING-WHEEL CENTERS BY WELDING

The wheel center first is turned true and at least ⅜ in. undersize, and the edges are chamfered ½x½ in. on both sides. A liner cut in three sections of equal lengths, and of such thickness as may be necessary, is then applied to the wheel center and held in place by heating and shrinking on a band made of an old tire (see sketch at right). The liner sections are then welded on both sides by depositing electrode metal in the ¼x½-in. chamfer. The band is then expanded and removed, and the sections are welded where they butt together. The wheel center is then turned to proper size.



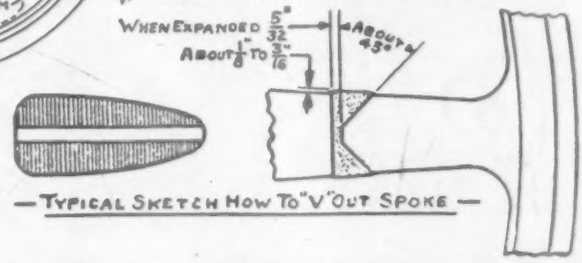
Torch-Holding Jig for Cutting Wheel-Center Rims.
(See last paragraph on this page.)



INSTRUCTIONS FOR REPAIRING SPOKE FRACTURES

Note 1. *Spoke is cracked next to the crank pin.* Cut a ¼-in. opening through the rim with a torch and insert a wedge to pry open the fractured spoke. Heat spoke No. 3 before welding (see sketch). After the welding operation is completed, remove the wedge and let the wheel center cool down and the rim return to its original position. Fill the ¼-in. cut in the rim with a suitable key, properly fitted, welded and ground smooth. Grind all other surfaces true. Shrinkage cracks in spokes should be removed with a file and the surfaces polished; if ¼-in. or more in depth, chip out the crack, cut the rim and weld.

Note 2. *Two adjacent spokes are cracked.* Tram the wheel center as shown in the sketch. Cut a ¼-in. opening through the rim at "Z" with the torch and insert a wedge at spoke No. 1. Vee out the cracks and weld spoke No. 1. Then cut a ¼-in. opening through the rim at "Y" with the torch and insert a wedge at spoke No. 2. With spoke No. 1 hot, weld spoke No. 2. Remove the wedges and let the wheel center cool down and the rim return to its original position. Fill the ¼-in. cuts with suitable keys properly fitted, welded and ground smooth. During the operation of repair, use suitable clamps to prevent the rim from moving out of line. If two spokes are broken that are not adjacent, treat each one as a single spoke.

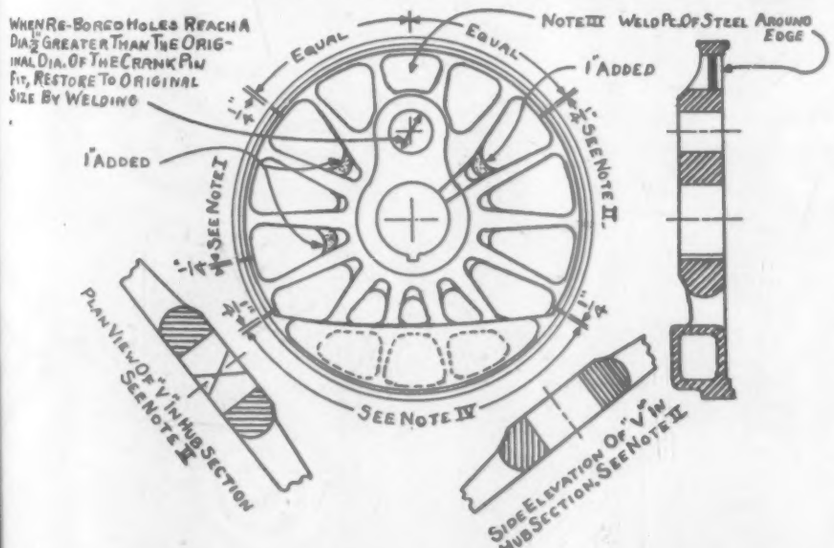


—TYPICAL SKETCH HOW TO "V" OUT SPOKE—

Note 3. *Spoke is cracked at the counterbalance.* Tram the wheel center as shown in the sketch. Cut a ¼-in. opening through the rim with a torch at each end of the counterbalance. Vee out the crack, and furnace-heat the wheel center to expand ¼ in. at the ends of the counterbalance. Tram to get 3/32 in. space at the spoke fracture. Weld the fracture and let the wheel center cool down so the rim returns to its original position. Fill the ¼-in. cuts in the rim with suitable keys properly fitted, welded and ground smooth. Tram to determine the amount of expansion and whether the rim returned to its normal position when cool. During the operation, use suitable clamps to prevent the rim from moving out of line.

Note 4. *Single spoke is cracked.* Tram the wheel center as shown in the sketch. Cut a ¼-in. opening through the rim with a torch and insert a wedge to pry open the fractured spoke. Vee out the crack, heat spoke No. 4, and weld. Remove the wedge and let the wheel center cool down and the rim return to its original position. Fill the ¼-in. cut in the rim with a suitable key properly fitted, welded and ground smooth. Grind all surfaces true.

INSTRUCTIONS FOR REPAIRING RIM AND HUB FRACTURES


WHEN RE-BORED HOLES REACH A DIA. 1/2" GREATER THAN THE ORIGINAL DIA. OF THE CRANK PIN FIT, RESTORE TO ORIGINAL SIZE BY WELDING
EQUAL
EQUAL
NOTE III WELD PL. OF STEEL AROUND EDGE
1" ADDED
1" ADDED
SEE NOTE I
SEE NOTE II
PLAN VIEW OF "V" IN HUB SECTION SEE NOTE II
SEE NOTE III
SIDE ELEVATION OF "V" IN HUB SECTION, SEE NOTE II

Note I. *Single fracture part way through the hub.* Vee out the hub to the bottom of the fracture. Cut a ¼-in. opening through the rim with a torch opposite to the fracture, as shown in the sketch. Heat the wheel center in the furnace at the fracture. Weld while hot, and build up 1 in. high. Then fill the ¼-in. cut in the rim with a suitable key properly fitted, welded and ground smooth. If the cracks in the hub between the spokes do not exceed ¼ in. in depth, indicating shrinkage cracks, and do not extend to the outer side of the face or the inside of the hub face, remove them with a file, polishing the surface.

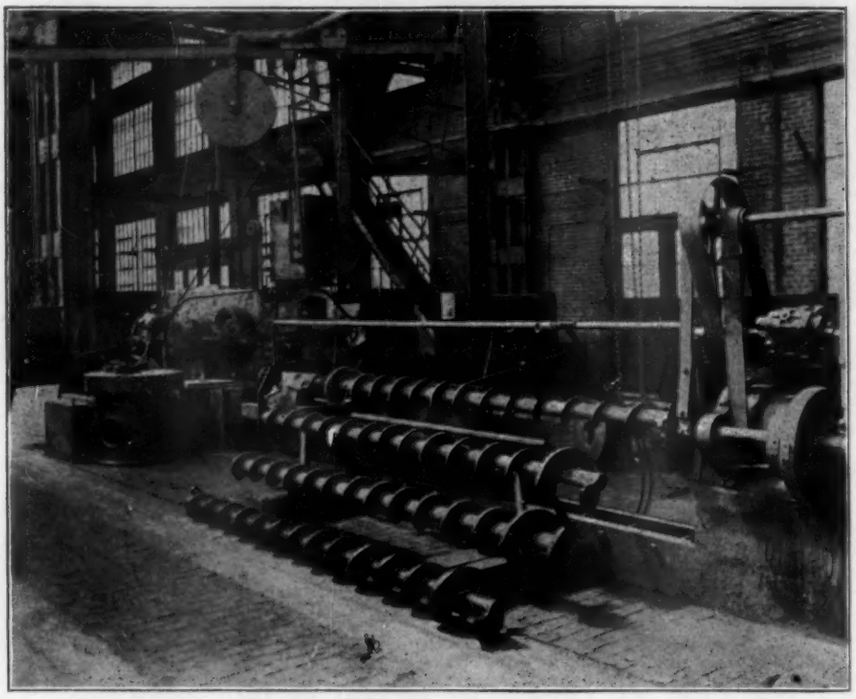
Note II. *Fracture through the hub into the axle fit.* Vee out between the faces so that the vees meet in the center. Cut a ¼-in. opening through the rim with a torch opposite the fracture, and another opening at a corresponding location on the opposite side of the crank pin. Heat wheel center at the fracture in a furnace to between 500° and 600° F. and weld the fracture with the center hot. Build up a reinforcement of 1 in. between the spokes on each side, as shown in the sketch. After the welding is done, place the wheel center in the furnace and heat the opposite side to the same temperature as the weld. If the fracture is 50% through the hub, it is veed out into the axle fit and welded as above. See sketch for plan and elevation of vee in the hub section. During the operation, use suitable clamps to prevent the rim from moving out of line.

Note III. *Main wheel centers.* On engines of certain classes, the opening between the pin hub and the rim is filled in with a piece of boiler steel of ¾ to 1½ in. in thickness, which is welded around the edge for reinforcement.

Note IV. *Rim is cracked at the end of the counterbalance.* Cut out with a torch and finish the end of the rim smooth. Then fill the ¼-in. cut in the rim with a suitable key properly fitted, welded and ground smooth. Do this at each end of the counterbalance. Use this procedure on new wheel centers to remove strain.

* * *

The keys referred to are a tight fit in the slot and of such size as to allow ¾ in. of welding completely around the key. In cutting the rim for expansion, a special jig, holding an ordinary cutting torch, is used. This jig is fastened to the wheel-center rim by two hand screws, and is mounted in such a position that the cut is held perpendicular to the face of the rim and directed radially toward the center. The torch may be moved across the rim at the desired speed by means of the crank. By the use of this jig, a good, square cut may be made.



Reclaiming Stoker Screws.

(The shafts are sand-blasted, then built up with steel electrodes, followed by a layer of cast-iron rod. The screw is straightened in a lathe, and V-strip is applied to the worn flights and welded. The flights and shafts are ground to size, then the screw is stress-relieved in an oil furnace, after which the grinding is completed.)

axle fits and undersize wheel-center diameters.

Certain Details Must Be Handled With Caution

In repairing fractures, there are certain general instructions that are followed as to nature of fuel, safety, chipping, etc. The heating is done by city-gas or oil torches. In all cases where spokes or hub fractures are to be repaired, the rim is cut for expansion. Precaution is observed in preheating, especially of the hubs, as the lead in the counterbalance may melt and blow out. Shields are applied to prevent the lead from causing damage. Each weld, after being completed, is ground smooth and stamped with the date, shop and welder's number. In all cases where hub fractures are welded, the wheel is normalized to 1500° F. after welding. Spoke repairs are stress-relieved by heating with charcoal or a torch.

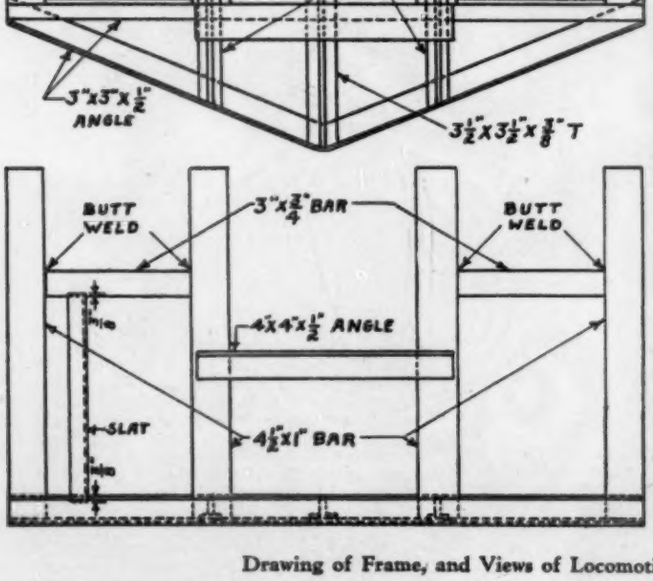
The Illinois Central is now manufacturing fabricated locomotive pilots for use on its system. The pilots are of standard dimensions and may be applied to any Illinois Central engine. The materials necessary for each pilot are: four 42-in. pieces of 4½x1 in. steel bar, two 17⅛ in. pieces of 3x¾ in. steel bar, one 29-in. piece of 4x4x½ in. angle, one 90-in. piece and one 74½-in. piece of 3x3x½ in. angle iron, two pieces of 2½x2½x¼ in. T-section, one 23-in. piece of 3½x3½x⅜-in. T-section, approximately 46 ft. of 2x2x¼-in. angle, and 9 lb. of welding wire.

Jigs and Dies Facilitate the Building of Pilots

By constructing pilots in fairly large lots and using a special jig and dies, considerable time is saved. The slats are cut on a special die, bent, checked and then stored in a numbered rack so that the proper slat may be easily obtained. The frame pieces are marked off with templates. All shearing and bending is done cold. In assembling the pilots, a jig is used which holds the frame members in place for welding. After all the frame members are welded, a pair of jigs for spacing and holding the slats are applied, and the slats welded on, which completes the welding. The steps are fastened on by bolts in drilled holes. The welding time averages about 4 hours per pilot. The accompanying sketch and photographs show the method of construction. On more recent constructions, a butt weld is used as shown on the frame sketch. Also, the slats are made shorter, only ⅜ in. being allowed for lap.

The procedure in the construction of an all-welded cab is as follows:

The sheets are cut to shape on rotary shears; the two sides, front and back are laid flat on the floor, and the corner angle irons are tack welded. These parts are then set up in a vertical position, the top and carlines are all tacked in place, and the welding is then completed. The cab is then turned upside



Drawing of Frame, and Views of Locomotive Pilots, Assembled and Welded in Jigs.

All-Welded Locomotive Cab.

down, a 2-in. coating of plastic asbestos is applied to the top inside, then the steel lining is applied, after which the cab is uprighted and the steel sash and door frames are applied.

Welding Saves Weight and Expense in Cab Manufacture

The weight of the all-welded cab is approximately 60 lb. less than the riveted cab, due to elimination of lap joints and rivet heads.

A saving of approximately $36 is effected by the all-welded product, due to elimination of laying out, punching and drilling of rivet holes, bolting up, reaming and driving the rivets.

After the fabrications are completed or the material has been reclaimed, all welds are ground to a smooth finish and are thoroughly inspected to see that the parts are free from flaws, undercutting, etc. The work is then transferred to the heat-treating furnaces, where it is stress-relieved and normalized.

We urge our operators to study available welding literature with the aim in view of improving their methods. This, coupled with practical daily work, has been a factor in the developments that we have made. At this time we have 54 men who are subscribing to trade and technical welding journals.

All welders are required to qualify before allowed to perform important work. This is done by means of weld specimens, which are inspected and test-

INSTRUCTIONS FOR MAKING TEST SPECIMEN WELDS

Part A must be completed in triplicate by the Engineer of Tests and forwarded along with weld test specimens.

Part B must be completed by the Operator, witnessed and returned to Engineer of Tests in triplicate with welded specimens.

Part C must be completed by Engineer of Tests, one copy retained for his file and two copies forwarded to Superintendent Motive Power, one of which will be retained and one copy returned to Shop Superintendent or Master Mechanic.

Tensile strength of base metal and minimum test results required shown on back hereof (reproduced below), also table showing amperage and voltage for various size electrodes.

Part A

(Shop) ..... 193.....

Kind of material in test specimen.....

Kind and size of welding rods to be used:	Oxy-Acetylene	Electric
Kind of welding rod	.....	.....
Size of welding rod	.....	.....

Part B

Report of test welds made at.....Date.....193.....

by..... Occupation..... Number..... Craft.....

DESCRIPTION:

If oxyacetylene process used—
Torch number .....
Tip number .....
Pressure of acetylene.....
Pressure of oxygen.....
Acet..... Elec.....

If electric process used—
Make of welding machine.....
Number of welding machine.....
Amperage..... Voltage.....
Length of arc.....

Name Foreman witnessing test welding operation .....

Personal signature of Operator making weld .....

Part C

WELD TEST RECORD — A - Acetylene, E - Electric

Name ..... No. ..... Location .....

Date	A or E	Base Metal	Welding Rod Make	Welding Rod Size	Elec. Welder No. or Torch No.	Make Tip	Elec. Welder Amp. or Pressure Acet.	Volts Oxy.	Arc Length	Yield	Tens.	Elong.	Red.	Frac. **	Bend

(Shop) .....193.....

Report of Examination of test specimens—

Tensile Test

	Acet.	Elec.
Yield	.....	.....
Tensile	.....	.....
Elongation	.....	.....
Reduction	.....	.....
Fracture	.....	.....
Bend test	.....	.....

**Remarks—

Acet.	Elec.
.....	.....

*Key—IW, Fracture in weld. OW, Fracture out of weld. PP, Poor penetration. S, Slag. G, Gas. C, Coarse grained. F, Fine grained.

TABLE ON RESULTS REQUIRED

Specification	Material	Minimum Tensile	Minimum weld test results required — Tensile Tests *S.A.	*B.E.	*B.A.	Bend Tests S.A.	B.E.	B.A.
19-L	Chrome-Van. forging steel	90000	81000	.....	.....	35%	20%	15%
2-L	Carbon forging steel	76000	68400	.....	.....			
3-L	Vanadium cast steel	75000	67500	.....	55250			
2-M	Carbon cast steel	65000	58500	.....	48750			
15-L	Boiler plate steel	55000	49500	41250	41250			
19-C	Mild steel	50000	45000	37500	37500			
15-L	Fire-box plate steel	48000	43200	36000	36000			

Weld bend tests should show the above minimum percentage elongation as measured over the weld longitudinally on the convex side of

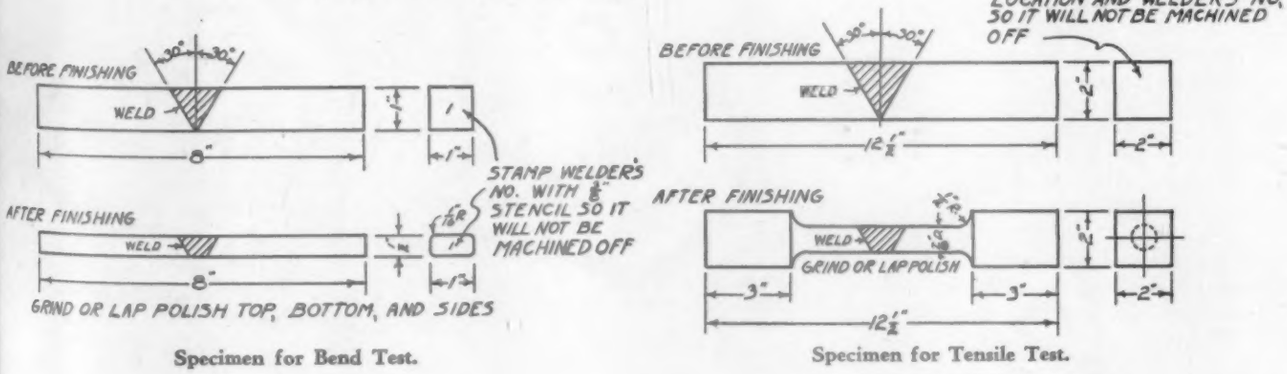
*S.A., Shielded Arc. B.E., Bare Electrode, B.A., Bare Acetylene Rod.

TABLE SHOWING VOLTAGE AND AMPERAGE TO BE USED BY OPERATORS IN THE USE OF VARIOUS SIZE ELECTRODES

Butt or Lap Welding — Size of Electrode	1/32"	1/16"	1/4"	1/8"	3/8"
Average amperage with arc voltage of 40 volts	110 to 150	130 to 175	175 to 250	225 to 300	250 to 400

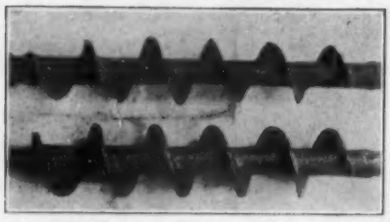
Vertical and Overhead Welding — Size of Electrode	1/16"	1/32"	1/16"
Average amperage with arc voltage of 25 volts	75 to 110	110 to 135	150 to 175

WELD TEST SPECIMENS



Specimen for Bend Test.

Specimen for Tensile Test.



Worn Stoker Screw (Top) and Reclaimed Screw (Bottom).

ed for yield, tensile, elongation, reduction, and defects. For each man taking this test, parts A, B and C (see "Instructions for Making Test Specimen Welds") are filled out.

Each Process Is Used Where It Gives the Best Results

Our system for insuring the maximum results in fusion welding is based fundamentally on obtaining the best welding rods or material, using the welding process best adapted to the work, studying the service and stresses to which the part is subjected, and having qualified welders to perform the work with qualifications as above outlined.

It is all-important that if one of the welding processes is to be used, it should be the best, and the one that will make the most economical welds. If the electric process gives a weld that is stronger, more ductile and in general better, it should be used, and the same as regard to oxyacetylene welding wherever it gives the best results. These actual tests develop the proper method of welding to be used.

If a job or piece is to be fabricated by welding in lieu of using a casting, a study should be made of the forces acting and the resulting stress, vibration to which the part is subjected, and the service in which it will be used. Proper design is probably more important in the fabricated or welded parts, for as a rule fabricated sections are made lighter.

During the process of welding, and after completion of the job, inspections of workmanship are made by competent personnel. Specimens may be taken from a welded job for determining the cleanliness and the quality of the weld.

As a matter of record, and to improve his efficiency, each welder is assigned a number, which is stenciled adjacent to all his welds on those parts where trouble might be experienced from failure or other cause. We find this an incentive for each welder to do his best. Probably as important, and one detail which might be overlooked, is the proper preheating, stress-relieving and normalizing of welded parts. It has been found by experience and study that the fullest returns cannot be obtained in fusion welding, unless these fundamentals are strictly adhered to.

Get "*H. O. T.*" on Welding

■ By H. O T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

That Big Tool Show in Cleveland

The biggest thing of its kind yet. It is the story of great confidence, the faith that industry has in America's future. Four days have I spent among men and machines. I feel like a child who has had too much rich food. It has been beyond me to comprehend it all. No one but Durante could think up all the adjectives to use in a feeble attempt to describe the bigness of it.

Much of my time was spent in studying the keen, alert faces of the men manning the booths. No matter what part of the country they came from, they radiated a solid, strong confidence. Not anything of a cock-sureness. But that grand feeling that those men knew where they were going and how they were going to get there. Their faith in themselves and the United States made you feel that they were just a bit more American.

And what a story it told for man and machine, of the future of welding! Those great machines, with their tremendous cast-iron bases and frames, pointed clearly to the hand-writing on the wall that in a not far-distant future these would be made from cut and welded shapes. When I first thought of ten days spent there I felt that one would become very weary of seeing it over and over again. But no! ten days would be all too short to digest it all.

The Harnischfeger Corp. had a new welding booth that was truly very clever. It was like a gigantic welding shield, affording excellent protection to the onlooker and a dandy view of what the operator was doing. My "congrats" to J. O. Ferch, advertising manager for that company, whose swell idea it was. I look forward to seeing more and more of these smart things at the various welding conferences that are coming this fall. These little smart ideas sure help to increase sales.

There were many very interesting people there and of course many big shots from near and far. The very talented and well-known welding engineer, Bob Kinkead, was among those. I had the great pleasure of dining with him and his equally charming and clever wife. Really swell folks. If there were such a thing as a 400 in the welding industry, as there is in society in New York, these lovely people would rank among the first few.

• • •

Just a Few Pertinent Comments

It seems to me that nearly every welding shop is always looking for wedges or shims, and out in their scrap pile are a flock of old mower blades. Just the thing where a small wedge or shim is needed. They are wide enough so that you can pile almost any number on each other in blocking the end of something up when you line it up before welding. And they can be used over and over again, and cost nothing.

•

One of the demonstrators of a cutting machine during the Tool Show lit the torch with a match—one of those experts whose job it is to help us common folks do things the right way. I noticed that there was a spark lighter within easy reach.

•

And speaking of spark lighters, that's one durn thing that seems next to impossible to keep handy in a welding shop. A good trick is to fasten them above the welding bench to a long spring and stout cord attached to the rafter or beam above. It is then always where you want it and you will be surprised how much longer they last. The loafers won't wear them out playing with them and the gents whose fingers are sticky or think you get them for nothing and insist on taking them home so that the old lady won't use so many matches will find that it is not quite so simple to walk out with it.

•

About two years ago I told you about an arrangement for picking up something heavy, like a motor from a truck. Just a simple thing made from old pipe, but a dandy thing to have around any welding shop. If you want a sketch of this, drop me a line and I'll mail it to you. Why do things like that by sheer strength and awkwardness? And there is always plenty of lifting in any welding shop, so why not make it easy?

• • •

The emptier the head, the less it takes to fill it!

Idealness is the cause of unhappiness!

A fellow has got to live, as well as die, so you might as well do your best while you are here, my lad!

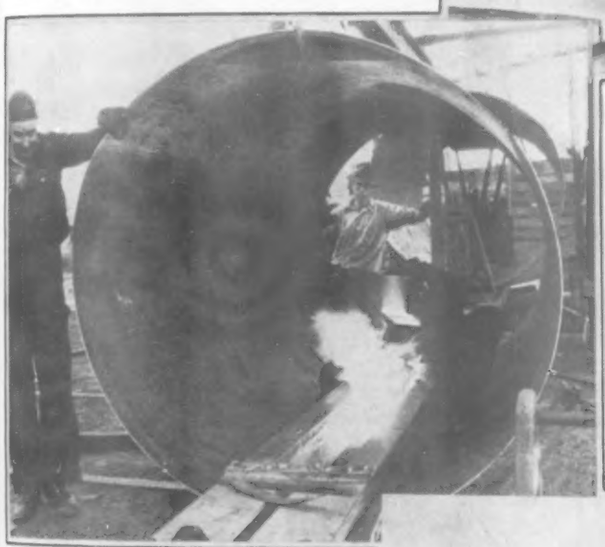
• • •

The thought for the month: Practise, without training, guidance, and complete understanding of what you want to accomplish, is time and effort wasted.

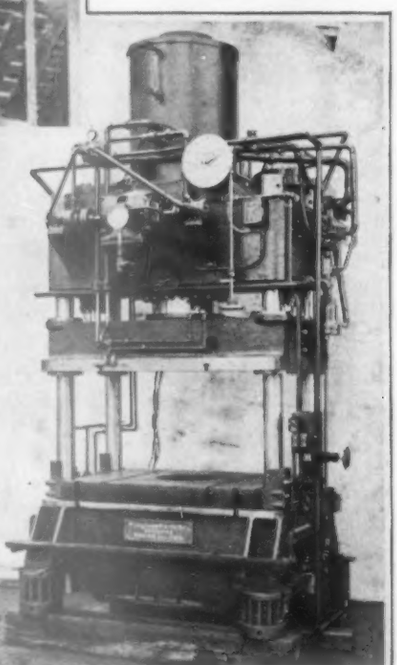
Welding News in Pictures

• All-welded steel storage tank, built by Thornton Co., Cleveland, for Harshaw Chemical Co., also of Cleveland. Plans for wood in top and bottom units were changed to welded steel, with 25% saving in cost.

• Samuel Levy, Manhattan Borough President, wields an oxyacetylene torch and cuts through a section of fire-escape on the first of the old tenements to be razed in New York City's lower east side $25,000,000 improvement project.



• Welding a section of pipe to form a part of the water-supply line from the Hetch-Hetchy dam in the Yosemite Valley, California.



• The high-pressure piping on this 500-ton draw press is made leak-proof by the use of welded joints and Tube-Turns.

• New 45-foot all-welded tug Beaver State built for the Great Lakes Dredge & Dock Co. by the Manitowoc Shipbuilding Co., Manitowoc, Wis. The deck house and pilot house are built into a single integral unit, allowing their ready removal for installing or taking out the engine. (Photograph by courtesy of The Lincoln Electric Co.)

The Equipment Buyer Gets Inquisitive . . .

■ By HARRIS A. GOODWIN
District Manager, The Bastian-Blessing Co.

? **Having adopted higher-quality materials and better production methods, resulting in quicker deliveries and lower weights and costs, with reduced selling prices, the alert factory-owner expects the same of the manufacturer who sells him equipment** ?

PHOTOGRAPHS BY COURTESY OF B. G. PURCELL, INC., DIVISION OF THOMAS WELDING LABORATORIES

THE expanding use of high-strength, light-weight, non-ferrous alloys for structural shapes, tanks, etc., is leading to a veritable revolution affecting many phases of industry and commerce. Take, for example, the vogue in gasoline-tank-trucks. Expedient design engineering has taken from 25% to 35% off the non-pay net weight of the carrier and converted it into *increased pay load* without increasing the gross weight of the loaded truck.

The developments in dow-metal, duralumin, and lynite have yielded new ammunition for the astute merchandiser. They have taken the "hackney" out of his sales approach. They have given him "meat" to sell to his customer in the form of a profit-making picture that cannot be ignored. From them have evolved the dirigible aircraft, high-compression motor, stream-lined high-speed train, and other equally revolutionary designs which distinctly influence our economic life.

Metal Industry Marches Forward With New Materials

The steel industry has recognized this threat to the supremacy of ferrous metals on the industrial stage. The action that it has taken has been in many directions. Let us consider in this article the revolution which is now going on in the heavy-machinery industry. The spheres of application of gray-iron, malleable-iron, semi-steel and steel castings have not been disturbed until recently. Until recent years, foundry practice remained practically the same as it was fifty years ago except for the developments in furnace design, for melting the metal.

Now we are embarking on a new era in heavy-equipment design—one that is bound to preclude the use of castings more and more from motor and Diesel-engine bases, punch presses, impact pulverizers; printing, pulpwood, and paper-making machinery, and a host of other equipment in which initial cost, inherent strength and transportation cost are fundamental factors which the sales department must consider.

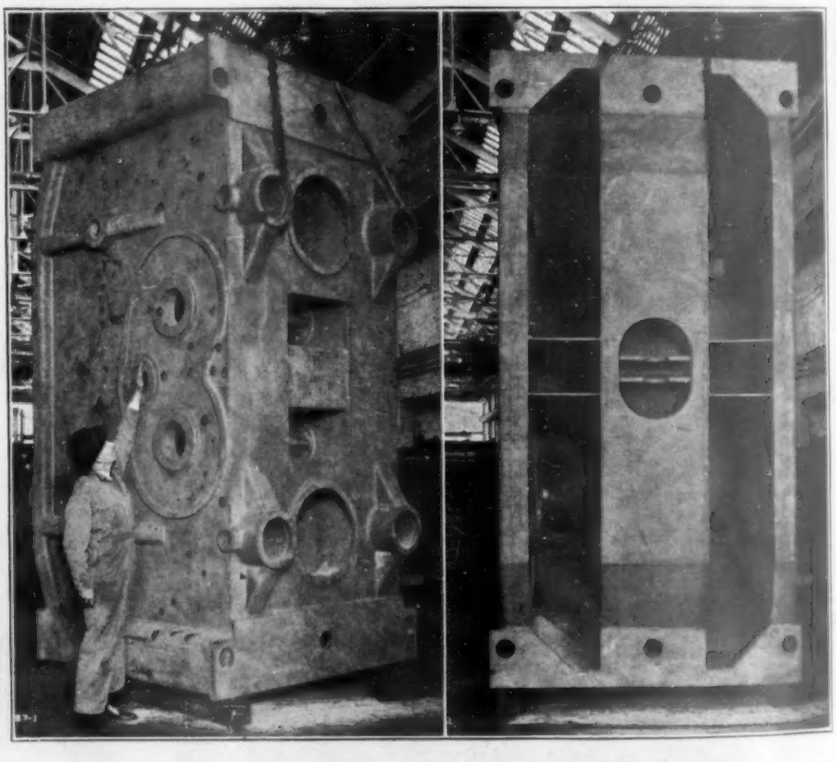
The buyer today is asking questions having bearing on these factors, as a result of his enlightened experience with his own manufactured articles. The foundry indeed is beset with an acute problem.

Two of the accompanying illustrations show views of a crown recently completed by the Thomas Welding Laboratories, Inc., of Detroit, for a 250,000-lb. press to be used by a large manufacturer of popular-priced motor cars. This particular piece of equipment is indicative of the economic revolution which the steel-plate fabricator has had a hand in introducing.

This press crown was completely fabricated from steel plate by means of oxyacetylene cutting and metallic-arc welding, and was *shipped thirteen days after the receipt of the order.* It weighs 36,000 lb.

Weight and Delivery Time Favor Welded Steel

The estimated weight of an equivalent gray-iron casting crown was 80,000 lb., and of an equivalent semi-steel casting 65,000 lb. The time which would have been required to make patterns and core boxes, to mold, pour and allow the 40-



Welded Plate Crown for 250,000-Lb. Press for Stamping Out Sides of Automobile Bodies. Over-All Dimensions, 154x90x78 In.

Actual weight of the piece	36,000 lb.
Estimated weight of equivalent gray-iron casting	80,000 lb.
Estimated weight of equivalent semi-steel casting	65,000 lb.
Lineal feet of flame cutting: ½ in. thickness	300 ft.
¾ in. thickness	450 ft.
⅞ in. thickness	30 ft.
2 in. thickness	80 ft.
Plate thicknesses used, ½, ¾, ⅞ and 2 in.	
Labor hours flame cutting	51 hours
Lineal feet welding	2,050 ft.
Labor hours welding	300 hours
Pounds of welding rod consumed	900 lb.
Labor hours forming and lining up	120 hours
Labor hours sand-blasting	8 hours
Complete fabricating time	12 days

Six All-Welded Aluminum Tanks.

The three small tanks are 8 ft.-6 in. deep by 6 ft.-0 in. high and weigh 1,000 lb. each; the large tanks are 8 ft.-6 in. deep by 8 ft.-0 in. high and weigh 1,200 lb. each.

The tanks are reenforced with a duralumin angle at the top, aluminum angle at the center and steel angle at the bottom. Note that the leg of the top angle is turned down to permit insertion of insulation under projection of the leg, preventing liquid overflow from entering the insulation protection of the galvanized-iron sheet. Cork or rock wool insulation is inserted between the tank wall and the galvanized iron exterior.

Total welding rod used	239 lb.	Thickness of aluminum plate	¼ in.
Total acetylene required for welding	2,000 cu. ft.	Duralumin, aluminum and steel angle reinforcements	2½ x 2½ x ¼ in.
Total oxygen required for welding	1,950 cu. ft.	Complete fabricating time	6 days
Total labor welding	149 hours		

ton casting to cool, and then sandblast preparatory to machining, is estimated at from 6 to 8 weeks.

Hence, there was a saving in the monetary-investment period in labor and materials of at least one month over that required by foundry practice, and the comparative figures indicate a possible money turnover of *from 3 to 4 times* that made possible by casting. The reduced capital investment means reduced overhead and increased profit per invested dollar.

The casting would require a maximum shipping weight of 40 tons, of which 22 tons was saved by means of welded plate fabrication. This represents an important saving in the delivered price.

Thomas Welding Laboratories report that the selling price of this press crown, sandblasted and ready for machining, was approximately equal to the cost of patterns and core boxes alone which would have been required for casting. This astonishing cost reduction is not to be over-emphasized, however, since there are many cases where the raw casting might be secured for less than welded plate fabrication would permit.

Transportation weight and erection weight both involve labor costs which are invisible contributors to the final cost of such an assembly and which many times render the purchase of the machine prohibitive.

Tailor-Made Members Allow Use of Higher-Grade Materials

The formidable appeal which welded plate fabrication offers to the buyer lies in the fact that this method of "tailor-making" heavy machinery members permits the intelligent use of finer grades of steel, of newly developed, higher-strength alloy steels. Through the medium of properly supervised welding and cutting procedures, these finer steels can be fused together to produce sections which have been known to weigh only 40% as much as equivalent gray-iron members; which in many cases cost only 60% as much as gray iron; and which have a strength of from 3 to 8 times that of gray iron of equal section, depending upon the type of steel plate employed in the part.

In the design of this crown, each member was specified for its own load-carrying requirements. This is an important technical advantage in favor of welded plate fabrication. Foundry practice requires in many cases that stiffeners, bosses and connecting members must be in proportion to the cross-section of the main sections to overcome the hazards of possible shrinkage strains and cracks during the cooling of the casting. In most cases such sections are out of proportion to the strength of the piece and account in some measure for the excessive weight encountered. This is especially true in gray-iron castings.

Welded plate fabrications are constructed according to strength requirements. Thus, members which must bear compression loads can be made of correspondingly lighter sections than would otherwise be required. Those in tension are specified in accordance with their specific requirements in much the same manner as the members of a bridge are specified. After assembly is completed, all locked-up stresses are effectively removed in a normalizing furnace.

Every casting, during pouring and subsequent cooling, is subject to faults, cold shuts, sand pockets and blow-holes. This hazard increases with the size and weight of the piece. Unfortunately, many of these flaws may appear superficial or may be hidden entirely. The manufacturer, upon discovering such a defect after machining, cannot afford to reject the piece. Therefore, resort must be made to reclamation by preheating and welding. The salvage is costly, but unavoidable.

Hidden faults which are not discovered during machining remain isolated in the finished piece and constitute an unknown threat to the strength of the member, frequently causing ultimate failure even in normal operation.

Welded plate fabrication, under experienced and intelligent supervision and control, avoids such hazards. It does require the training of a thoroughly competent staff of welding and cutting craftsmen. Such training necessarily requires an executive personnel possessing a fundamental knowledge of the fusion-welding processes.

Welding Foundry Compared to Sand Foundry

The essentials of the evolution of the welding foundry are not difficult to perceive.

In the first place, a staff of structural-welding designers replaces the staff of pattern and core-box makers. In this phase we see that the welding foundry operates from blueprints instead of patterns.

Second, in place of flasks, copes, drags, sand screens, molding machines, tampers, etc., the shop must be equipped with oxyacetylene-flame-cutting machines and manually operated flame-cutting outfits for portable work. A shaper is also required, capable of making short-radius bends. The operators perform the comparable function of casting molders.

Third, in place of fusing the entire section in one enormous furnace, the welding foundry is equipped with a number of oxyacetylene- and electric-welding outfits which fuse the adjacent members of the section together, using the principle that the oxyacetylene flame and the electric arc are miniature crucibles wherein high-quality alloy steels are used to cast these rolled sections into one continuous piece.

The completed assembly described required a 20-ton traveling crane to convey it to the annealing furnace, where it was normalized and all locked-up stresses removed before sand-blasting.

The welded-steel institution is nothing more than a foundry which has found a way to eliminate patterns, core boxes, molding machines and an unwieldy central cupola furnace, and has adapted itself to the fabrication of rolled aluminum, nickel or copper alloys when the service requires such metals, in addition to steel.

It has the economic advantage of combining, under one capital investment, equipments which are alike capable of constructing Class 1 or Class 2 pressure vessels, pipe manifolds, fabricated plate to replace castings, as well as non-ferrous-metal products.

Welding as an Aid to the Making of Quality Steel Castings . . .

■ By C. M. UNDERWOOD and E. J. ASH
Senior Welding Engineer, Naval Gun Factory
Assistant Metallurgist, Naval Gun Factory

WELDING has been used to a limited extent by the Naval Gun Factory in repairing quality steel castings. Minor surface repairs have been permitted where stresses of low magnitude were involved and a satisfactory finish was essential. Some form of electric-arc welding has generally been employed for the most economical results.

For a number of years carbon-arc welding was used extensively but deposition by this method is usually lacking in the desirable physical characteristics. Metallic-arc welding with bare electrodes has been used more recently. Depositions with this material produce physical properties ranging from 55,000 to 60,000 lb. per sq. in. tensile strength but having only 2% to 8% elongation, with fatigue and impact properties proportionately poor.

Covered Electrode Hastens Use of Welding for Casting Repair

Until such time as better welding materials became generally available, the application of casting repair by welding was obviously limited. During the past several years, however, a very satisfactory type of mild-steel covered welding electrode has been developed.

Covered electrodes are now used extensively for numerous forms of fabrication. The properties of the deposited material acceptable for naval use range from 60,000 to 70,000 lb. per sq. in. tensile strength, 45,000 to 55,000 lb. per sq. in. yield point, 20% to 30% elongation in 2 in., 60 to 70 ft.-lb. Izod impact values, 26,000 to 30,000 lb. per sq. in. endurance limit, and other physical properties proportionately satisfactory.

To keep pace with the rapid advancement and more general use of alloy steels, numerous types of covered, alloyed rods have also been developed. More outstanding among these are the ferrous alloys of manganese, nickel, molybdenum, nickel-copper and manganese-vanadium.

The alloying elements in weld deposits are obtained by using an alloy steel core, by pick-up through chemical reaction with the covering, or by a combination of the two methods. Tensile strengths ranging from 80,000 to 110,000 lb. per sq. in., with elongations varying from 25% to 15% are obtainable.

WELDING low-alloy castings susceptible to air-hardening, possibilities of removing hardness by proper bead sequence, and removal of stresses produced by weld heating and contraction, are among the problems considered in this article, which is abstracted from a paper entitled "X-Ray and Welding—The Foundryman's Aid to Quality Steel Castings," read at the annual meeting of the American Foundrymen's Association, held in Toronto, Canada, Aug. 20 to 23, 1935.

The alloy rods as yet have not had the extensive application of mild-steel electrodes, but some of them appear particularly promising and may prove entirely satisfactory for application where higher physical properties or homogeneity of the repaired section is essential.

Mild steel in its various rolled forms is now being extensively fabricated by arc welding. When similar welding procedures are applied to steel-casting repair, however, unsatisfactory results are often obtained. Casting repair involves a number of peculiarities which must be taken into consideration.

Many steel castings are of a chemical composition not ordinarily suited for welding. Such alloying elements as carbon, chromium, nickel, manganese and silicon are common hardening elements which are affected by welding temperatures. Carbon, being the most potent alloying element, should be kept within satisfactory low limits, preferably not exceeding 0.18% to 0.25%.

The greater the amount of metallic alloying elements, the more the necessity for lower carbon content. It has been the contention of numerous foundrymen that carbon contents of 0.15% to 0.20% do not pour satisfactorily for complex designs. It is the opinion of the Naval Gun Factory that even though the low carbon content may be conducive to some defects, it is better to have castings that can all be readily repaired by welding, than to have castings with fewer defects but which cannot be satisfactorily repaired by welding.

The amount of manganese, nickel, or chromium employed as alloying elements is usually determined by the physical requirements to be met. Molybdenum and vanadium, in quantities commonly used, can fortunately be made to improve physical properties and at the same time produce a material that is weldable.

Preheating Should Be Resorted To, If Air-Hardening Is a Factor

When it is necessary to weld low-alloy castings which are susceptible to air-hardening, several procedures may be followed. For example, the castings may be preheated in order to retard the quenching effect of the casting mass surrounding the heated area adjacent to the weld deposit, thus preventing undue hardness. Preheating is usually accomplished by means of oil or gas burners placed at numerous locations about the casting to be welded. Where facilities are available, furnace heating of the casting is preferable, as more uniform temperatures are possible. The casting can be removed from the furnace for welding and replaced in the furnace at intervals in order to maintain the temperature within satisfactory limits.

For larger castings, where furnace facilities are not available, charcoal fires may prove satisfactory. Preheats of 200° to 400° F. are usually sufficient for low-alloy-content castings. Materials readily air-hardenable may require much higher temperatures, however.

Repairs are often necessary in difficult places, such as in internal parts of castings where it is impossible for operators to work on preheated material, so resort must be made to other methods. The use of higher currents, in applying the weld, although adverse to conventional practice, is effective. This practice makes a larger heat-affected zone but a

more gradual hardness gradient from the inner hard area to the outer less-hardened or unaffected area. The quenching effect will not be so rapid and stress concentrations will not be as severe.

Multiple-Layer Welding May Be Substituted for Preheating

By spreading out the heat-affected zone resulting from the first layer of weld metal applied, subsequent layers of weld metal can be added over the first while the welded area is still warm. The heat of the second or subsequent layers will penetrate through the first layer and into the heat-affected zone sufficiently to draw the major portion of the hardness. By properly timing this multiple-layer sequence, it is possible to produce a weld without detrimental effect in a casting that is normally air-hardening. Where large areas are to be welded, the cast-steel surface can be covered by such a multiple-layer method. After having once covered the area in this manner, it is possible to continue welding with no further precautions than are necessary on a similar mild steel material. The additional deposits will, of course, be placed entirely on the weld metal, which does not have air-hardening properties.

The sections shown in Fig. 1 demonstrate the possibilities of removing hardness by proper bead sequence. A single-layer weld on a steel very susceptible to air-hardening will give Vickers* hardness readings up to 579. A second bead reduced the hardened zone resulting from the first bead to 318, but created a second heat-affected zone with a hardness up to 469. A third overlapping bead drew the maximum temper of the first two beads to 287 but produced a maximum hardness of 384 in its own small heat-affected area. A fourth overlapping layer was sufficient to remove the major portion of the remaining hardness, reducing it to 270-280 as compared with 230-260 of the original material.

Weld Area Must Be Properly Prepared for Welding

In preparing castings for welding, all scale, silicates or other foreign material must be thoroughly removed from the weld area as these substances will contaminate the weld deposit and cause unsatisfactory physical properties. Where the defects are large they may be removed with gas cutting-torches, lances, or air chisels. An experienced chipper can usually follow such defects as small cracks or hot tears by watching the manner in which the chisel chip splits.

When no further defect can be detected, the cavity may be ground and polished for etching. In this manner any small associated defects remaining on the cavity surface are readily detectable. At the same time the groove can be satisfactorily shaped for welding; that is, the walls must not be too vertical, the bottom of the cavity should be properly rounded and surfaces to be welded made reasonably smooth.

It is preferable to weld castings in the downhand or flat position. Electrode sizes of 3/16 and ¼ in. are normally used with fairly high currents. This practice does not lend itself to vertical or overhead welding. Where necessary, vertical and overhead welding may be accomplished with smaller rods and lower currents.

Weld metal should be applied in thin layers rather than in cylindrical beads wherever practicable. By using the layer method, each deposit may recrystallize the metal previously applied, producing a fine-grain structure of superior physical properties.

Conditions Causing Defect May Also Operate to Cause Weld Failure

Stresses produced by weld heating and contraction are the most important factors to bear in mind. Original cracks, hot tears and shrinkage are often due to the designed shape of the casting or the pouring practice. Frequently these defects occur in or near the junction of light sections to heavy surrounding stiffeners or in lighter sections due to failure of the mold to collapse. The conditions that caused the original defect may also tend to cause the repair weld to crack.

The heavy sections rigidly support the defective areas, so little contraction can occur while the weld cools. Stresses produced by welding, therefore, must be largely absorbed in the weld metal itself. These stresses increase accumulatively as the welding progresses. Until the time that the weld is completed, its cross-sectional area is smaller in comparison with the cross-sectional area of the adjacent casting. The incompleted weld deposit therefore cannot stand as large a stress as the casting, although the physical properties of the weld deposit itself may be superior.

Unless precautions are taken, internal cracks may originate in the weld. These cracks sometimes spread as the welding progresses, two or three layers beneath the deposited surface. The cracks may extend 40% to 90% through the weld and still be detectable only by x-ray or similar examination.

The improved elastic properties of covered-electrode deposits are frequently demonstrated. Yet when the same de-

*Vickers hardness readings are used because of the small area required for test. The Vickers numbers listed are Vickers, pyramidal diamond, 30-kg. load, objective 2/3 in. They correspond closely to Brinell hardness numbers up to 300 but are increasingly higher than corresponding Brinell readings from there up.

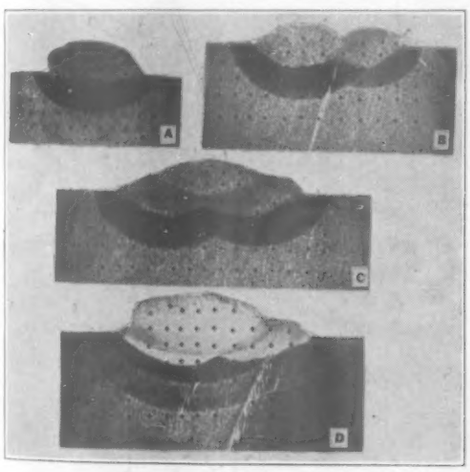


Fig. 1. Photomacrographs of Welds on an Air-Hardening Steel, With Hardness Readings Given.

(Carbon, 0.39%; manganese, 0.63%; silicon, 0.22%; nickel, 2.99%; sulphur, 0.038%; and phosphorus, 0.048%.)

A—With the single-bead weld, an exceedingly hard zone has been produced in the base metal adjacent to the weld, as evidenced by the Vickers' hardness tabulations (see below).

B—A second weld bead has been laid beside the bead shown in *A*. Part of the hardness of the first pass has been reduced, but a new hardened zone has been created.

C—A third weld bead has been laid over the two weld beads shown in *B*. The hardening effect of the first two beads has been sufficiently reduced, but a small hardened area beneath the third bead has been created.

D—A fourth bead has been applied over the third bead of *C*. By the application of a multiple-layer sequence of welding, hardened areas in the parent metal have been removed.

VICKERS HARDNESS VALUES OF WELD SECTIONS

A—				306	318	306	337	284	275								
				281	269	289	269	303	279	277							
236	248	517	543	511	401	376	517	550	579	240	238						
226	238	242	454	499	499	511	481	406	248	238	236						
230	232	240	252	248	258	242	244	244	244	236	236						
228	230	238	238	240	242	238	230	238	238	226	234						
B—				217	207	214	189	199	224	244							
236	331	459	228	242	234	221	202	200	248	327	281	260					
236	254	429	469	318	312	429	429	275	318	337	254	258					
238	228	256	362	419	429	396	279	267	265	250	256	256					
240	238	236	236	258	258	244	244	242	250	258	254	260					
234	238	236	234	234	234	265	244	250	254	246	256	263					
C—				192	204	202	194	194	188								
				198	193	200	198	198	196	198	200	215					
236	232	324	254	221	208	204	202	191	199	200	200	217	337	354	254	269	
242	240	258	331	315	240	199	228	376	275	210	217	324	348	318	263	272	
234	242	234	267	301	303	284	269	246	240	292	318	309	281	250	260	265	
240	238	234	238	236	244	240	242	234	238	234	246	246	252	260	258	265	
234	230	232	242	242	238	234	244	242	242	242	246	252	254	250	263	267	
D—				167	179	178	178	177	179								
				166	165	166	174	173	166	185	200	185					
232	242	256	256	174	182	172	172	177	187	193	196	189	240	242	254		
236	236	244	254	254	215	177	179	298	221	232	267	240	269	240	267		
242	236	240	250	250	252	256	275	252	246	265	242	238	234	267	267		
234	236	234	240	246	248	254	248	246	236	269	260	269	269	272	272		
238	236	242	242	236	230	246	228	240	256	260	267	269	275	275	279		

posit is made in casting repair, cracks may result with little or no evidence of distortion. This paradox is caused by the complicated stresses that may be set up in welding rigidly supported areas. For example, consider a volume of material acted upon in all directions by forces that are equal and opposite. Although the magnitude of the opposing forces may be varied through wide ranges no distortion will occur as long as the forces remain equal and opposite. No evidence of strain will appear until the cohesive strength of the material has been exceeded. Rupture will then result. Also, with casting repair, contraction may induce heavy stresses that are nearly equal and opposite. The result may be cracks occurring in a ductile deposit with little forewarning evidence of stress. Such cracks are frequently internal.

Stresses May Be Controlled by Preheating or Peening

There are several ways of reducing weld-stress concentrations. Preheating causes the weld to cool more slowly so that less stress is set up by the welding operation. Maintaining the casting at moderately elevated and relatively constant temperatures is very advantageous. Expansion and contraction are then held within a small range so that the full effect of shrinkage is not exerted. It is necessary in such cases to work continuously on a job once started until it is completed.

On complicated jobs it is preferable to place the finished casting immediately in a furnace for stress annealing without permitting the casting to cool. The additional stresses set up while cooling from the preheat to room temperature are thus avoided.

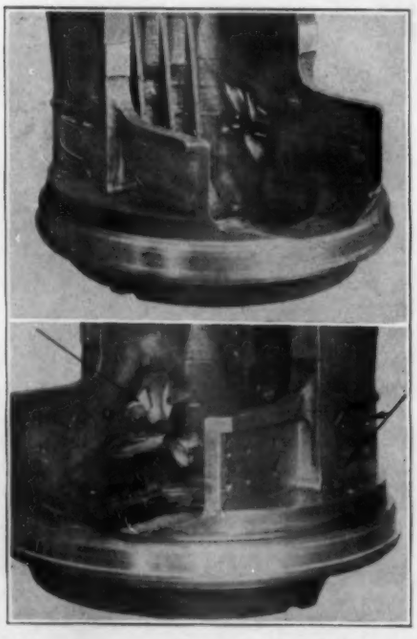


Fig. 2. Carriage Casting for 5-In. 38-Caliber Gun. Defective Areas Near the Base Have Been Removed.

Fig. 3. Section of Casting, Showing Areas From Which Defects Have Been Removed.

Fig. 4. Casting With Defective Areas Removed.
(The surfaces have been polished and etched during the course of inspection.)

Peening is the most potent means of controlling stresses, preventing cracks and avoiding distortion. This operation must be very carefully done if it is to be effective; however, its misuse may be equally harmful. When peening is to be employed, layers of weld metal should be deposited so that their surfaces are as smooth as possible.

Irregularities that occur should be removed by chipping or grinding so equal work will result throughout the deposit from application of the peening tool. All slag or foreign material must, of course, be carefully removed. Peening should follow the smoothing and cleaning operation as quickly as practicable.

The peening operation is preferably accomplished by means of a rounded or blunt-nosed tool in an air hammer. Rapid, light blows should be used so that the metal will flow smoothly, as in the heading of a hot rivet, rather than heavy blows, which may tend to tear or rupture the metal. By peening immediately after welding, while the deposit is still hot, less work is required to accomplish a given result and the metal is more ductile so that detrimental effects are less likely to occur. Peening at this time also prevents contraction stresses, which would possibly cause cracking or distortion.

First Layers on Air-Hardening Steel Should Not Be Peened

If the material being welded is subject to air-hardening, care must be taken not to peen the first two or three layers, as blows from the peening hammer will be inducive to cracking in the hardened zone beneath the weld deposit. Where the cavity to be repaired extends all the way through the casting, the first few layers of weld metal closing the void should not be peened. Sections of this nature may be too thin to withstand the mechanical working, and subsequent cracks may possibly develop.

Care must be taken that no undue irregularities in the weld surface are peened down, as this will cause folds in the underlying metal which will be covered over and remain as a void in the deposit. Excessive peening must be avoided as compressive forces can be introduced which are detrimental and in extreme cases may cause warping in the reverse direction to that anticipated. Personnel can be trained so that they can perform peening operations effectively. Little supervision is required once a suitable routine has been established. If peening is properly done it is very helpful in preventing distortion and in the production of satisfactory weld repairing.

Hardened Areas Next to Weld Can Be Relieved by Heat-Treatment

Castings which have been welded so that hardened areas exist adjacent to the weld should be heat-treated in order to

Fig. 5. Welded Area Partially Completed.
(Slag and irregularities have been removed from the weld surface in preparation for peening.)

Fig. 6. View of Completed Weld Repair.
(The reinforcement has been removed, and the surfaces polished and partly etched.)

Fig. 7. With the Weld Repair Completed, a Surface Examination and X-Ray Inspection Disclose No Further Defects.

relieve this condition. The usual practice of heating slightly above the critical temperature, and furnace cooling, is a satisfactory method. In some cases it may be practicable to weld castings before any heat-treatment. Deleterious areas resulting from welding will then be removed during the normal heat-treatment cycle subsequently performed on the castings. Such practice must be used with caution, however, as green castings may contain heavy initial stresses, and in their coarse-grained, brittle condition are vulnerable to cracking.

Stresses induced by welding may be satisfactorily relieved in most cases at temperatures of 1100° to 1200° F. There is no change in microstructure at these temperatures, but the tensile strength of most low-alloy steels is reduced to 6000 or 8000 lb. per sq. in., so that residual stresses in excess of this amount will adjust themselves. Temperatures of this magnitude are usually not sufficient to cause warping of the casting due to its own weight and should not cause heavy scaling.

The usual procedure is to heat the casting slowly with the furnace, hold for one hour per inch of thickness of the heaviest section, and cool in the furnace. Lower temperatures may be equally effective if employed for sufficiently long periods of time. The required holding periods increase rapidly with lower temperatures so this procedure is usually inadvisable.

Naval Gun Factory castings are necessarily of high quality in order to be satisfactory for the exacting requirements of ordnance use. Due to the complicated nature of some parts, however, casting difficulties are sometimes encountered. As a demonstration of the practicability of the foregoing principles an example of weld repair is cited.

3000-Lb. Gun Carriages Are Reclaimed by Welding

A number of carriages for a 5-in. 38-caliber gun (main supporting member for the gun and associated mechanism), Fig. 2, had been cast, heat-treated and finished machined ready for assembly before x-ray equipment was installed. After x-ray inspection was established, it was found that a great many of these carriages had extensive defects in a highly stressed area near the base. Examination of pilot castings and extensive machine work in the defective area failed to disclose the internal hot tears, although a number of them extended 80% to 90% through the finished cross-sectional area.

These finished carriages weigh approximately 3000 lb. In order to reclaim these parts, repair had to be effected without appreciable distortion. After considerable experimenting on sample pieces and pilot models, the following repair procedure was established:

Castings were x-rayed in all defective areas and the defects traced on the outside of the casting. Chippers using heavy air-operated chisels removed these defective areas. This operation was followed by grinding, buffing and etching in order further to determine that all visible cracks, tears or voids were completely removed (see Figs. 2, 3 and 4.) If the defective area did not extend entirely through the casting, the remaining cross-sectional area was x-rayed in order to detect further tears that might exist beneath the etched surface. This procedure was repeated until all defects were removed. The casting was then ready for welding.

Welding Procedure Involves Definitely Timed Cycle

The carriages were placed in a convenient position for welding and preheated to between 200° and 300° F. A definitely timed welding cycle was started and continued at a rate that would maintain the casting at this temperature until the weld was completed. The welding cycle consisted of applying a layer of weld metal in the defective area, removing the slag from the weld, grinding or chipping irregularities from the weld surface when necessary, and chipping out any defects from the weld deposit, such as gas holes, slag inclusions, etc. (see Fig. 5).

Following this preparation, the weld was peened by an especially trained operator who had been taught the correct amount of peening from practicing on pilot samples. A crew of men trained for the welding, chipping and grinding operations performed their successive duties in the required order on several castings. The number of castings worked upon at a time depended upon the size of welds, but care was taken so the time interval automatically maintained the desired temperature in each casting. All welds were reinforced or built up approximately ¼ in. thicker than the casting before being permitted to cool.

After the welding was completed and the casting had cooled sufficiently, the excessive weld metal was removed, the area polished, ground, etched and examined for surface defects (see Figs. 6 and 7). All welded areas were then x-rayed. If any further defects in the casting or

Fig. 8. Stress-Relieving Furnace for Treating Repaired Portions of Carriages.

Fig. 9. An Area Containing Numerous Small Tears.
(In a case of this kind, it is advisable to remove the entire section and replace with a plate of similar section and properties.)

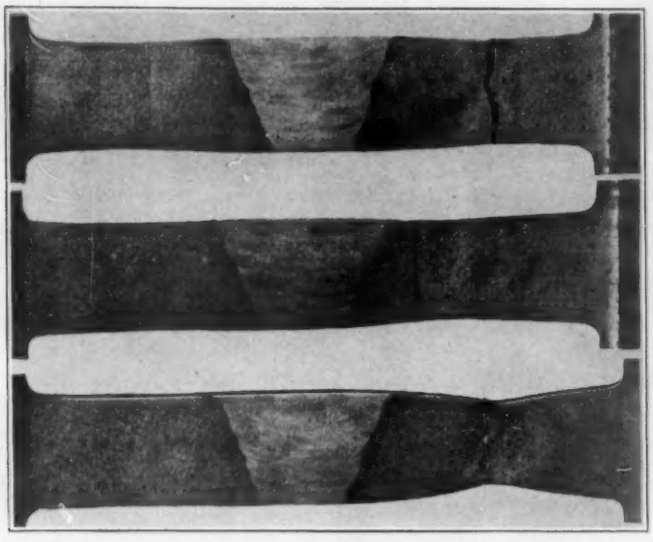


Fig. 10. Full-Section Tensile Test Demonstrating Superior Tensile Strength of Weld Metal.
(Rupture occurred at 62,000 to 67,000 lb. per sq. in., depending upon the casting strength.)

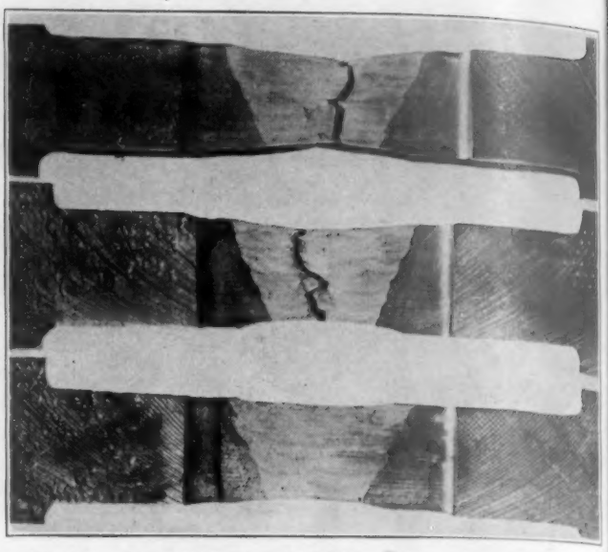


Fig. 11. Tensile Specimen Machined So Minimum Section Is at Center of Weld.
(Rupturing stress of weld metal, 70,000 to 75,000 lb. per sq. in.)

cracks and tears in the deposited weld metal had developed during the welding operation, the defects were removed and the repair process repeated. In this manner all questionable areas were eliminated.

After Welding, Carriages Are Stress-Relieved in Furnace

After completion, the carriages were placed in an especially constructed stress-relieving furnace. This furnace, Fig. 8, was designed so that heat would be applied only to the repaired area and no oxidation resulted on the trunnion bearing supports. The heat gradient was gradual between the heated portion and the external sections so no serious stresses were introduced. The welded area was gradually heated to a temperature of approximately 1100° F. during a period of 8 hours, held at this temperature for 3 hours, and permitted to cool in the furnace for a period of 12 hours. The carriage was then removed and the light oxide buffed from the finished machined surfaces.

In cases where warpage beyond the permissible tolerances resulted, the parts were ground undersize until the low spots were removed. The undersize pad or bearing races were then electroplated to the required dimensions. This procedure was found necessary only in cases where 20 to 30 lb. of weld metal had been added or where residual stresses were already in the casting.

On some carriages where the defective area consisted of numerous small tears, the entire questionable section was removed (as shown in Fig. 9) and replaced by welding in a plate having similar physical properties and cross-sectional area. After completion, the carriages went into the regular assemblies. The assembled guns were given their proof-firing test and all repaired areas again x-rayed. The additional examination was to determine whether any appreciable cracks had occurred between the time welding was finished and stress-relieving was completed or during proof firing.

X-Ray Checks Follow Proof-Firing Tests

Final x-ray checks of the castings so repaired have disclosed no further defects after subjecting them to proof-firing tests, in which larger powder charges were used than are employed in regular service firing. Tests demonstrating the desirable physical properties obtained in this repair job are shown by Figs. 10, 11, 12 and 13. Weld-metal performance in physical tests is usually demonstrated by perfect deposits made under laboratory conditions. The above illustrated tests were taken from shop production rather than selected specimens and demonstrate the relative merits of weld metal and cast metal obtained under average production condition.

Welding, if properly applied, can be used effectively to repair extensive defects which may occur in castings from time to time. The soundness of weld repair can be further assured by x-ray examination. Not only can welding be used for repair of defects, but complicated castings may be molded in several simplified sections and subsequently assembled by welding them together to form a less expensive and more dependable final product.

The Foundry and the Fabricating Shop Will Benefit by Cooperating

The foundryman and the weld designer have in too many cases been rivals since the extensive introduction of weld-fabricated rolled steel to replace castings. It appears, however, that cooperation between these two processes will offer advancement in steel construction. Heavy, complicated sections of

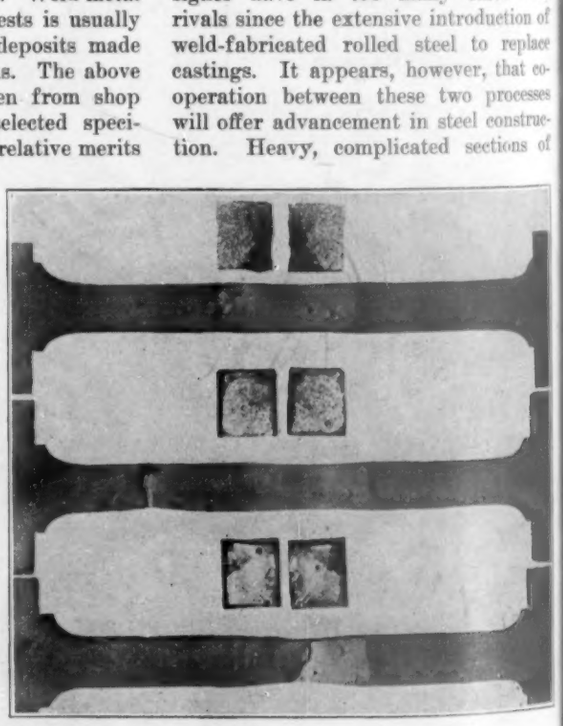


Fig. 12. Tensile Impact Tests Simulate Firing Loads.
(The striking velocity of load was 21.35 ft. per second, and energy of rupture was 1668, 1718 and 2141 ft.-lb. from top to bottom, respectively. The fractures occurred at imperfections in the weld or casting as shown by the ruptured section.)

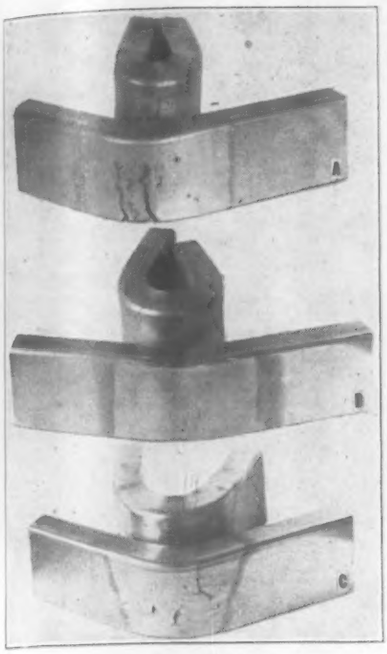


Fig. 13. Free-Bend Tests of Specimens of Welded Steel Casting.

A—Elongation before stress-relieving, 24%. The same section stress-relieved, 41% elongation. *B*—Elongation before stress-relieving, 9%. The same section stress-relieved, 44% elongation. *C*—Elongation, before stress-relieving, 21%. The same section stress-relieved, 40% elongation.

sufficiently uniform thickness may be readily cast. Large, light-weight sections are rolled, drawn and weld-fabricated advantageously. In numerous cases, an assembly, partly of rolled stock and partly of steel castings will be the optimum in the effective use of metal and in fabricating costs.

The x-ray and welding are two of the newer tools of the foundryman. Thus far we have had some very successful applications, but the field is still naissant. With proper design and carefully controlled procedure, stronger, lighter and more uniformly high-quality steel products may be expected.

Steel Electrical Engineers to Hold Welding Session

A program devoted to welding will be held under the auspices of the Welding Engineering Division of the Association of Iron and Steel Electrical Engineers, during the 31st annual convention of the Association, to be held in Pittsburgh, Pa., Sept. 24th to 26th. Five papers on welding will be delivered, beginning at 2 p.m. on Sept. 26th, in the main ball room, on the 17th floor of the William Penn Hotel. The following papers are scheduled:

"Developments in Welding in 1934-35," by Grover A. Hughes, Truscon Steel Co.; "Alternating-Current Arc Welding," by W. W. Reddie and E. Steinert, both of the Westinghouse Electric & Manufacturing Co.; "Welding in the Steel Industry," by E. W. P. Smith, The Lincoln Electric Co.; "Welding With the Alternating-Current Arc," by H. A. Winne, General Electric Co.; and "Developments in the Use of the Oxy-acetylene Process in the Iron and Steel Industry," by E. J. W. Egger, The Linde Air Products Co.

Builds Brine Tanks by Welding

An all-welded brine tank was recently constructed for the Bartonville State Hospital, by the Superior Welding Co. of 331 Knoxville Ave., Peoria, Ill. The actual welding time was 24½ hours. This tank is 25 ft. 9½ in. long, 22 ft. wide and 4 ft. deep, and built of ¼-in. steel plate. Vertical seams were welded with 5/32-in. electrodes, while 3/16-in. electrodes were used to weld the bottom. All electrodes were of the shielded-arc type.

Another tank of different design, 29 ft. long, 25 ft. wide, 4 ft. 1 in. deep, with 2-in. lap joints and broken corners, was built at the T. P. & W. Railway Ice House, the week of Aug. 16th, also by the Superior Welding Co. Bolts were placed every 3 ft. in this tank, and then removed after tacking the plates securely. Five hundred feet of welding was done, using 5/32-in. electrodes on the vertical seams and 3/16-in. for welding the bottom of the tank.

Another contract has been awarded the same firm for the construction of a similar tank at Woodruff's Ice House on the Galena Road, Peoria, Ill.

Arc Welding Saves Bridge Having Corroded Stringers

Ten thousand dollars was recently saved the city of Cleveland, Ohio, when the badly corroded stringers of a 50-year-old bridge were strengthened by arc welding, according to Paul Simon of the Ohio Machine & Boiler Co., the concern which repaired the bridge.

Corroded Stringers on Cleveland Bridge Repaired by Welding.

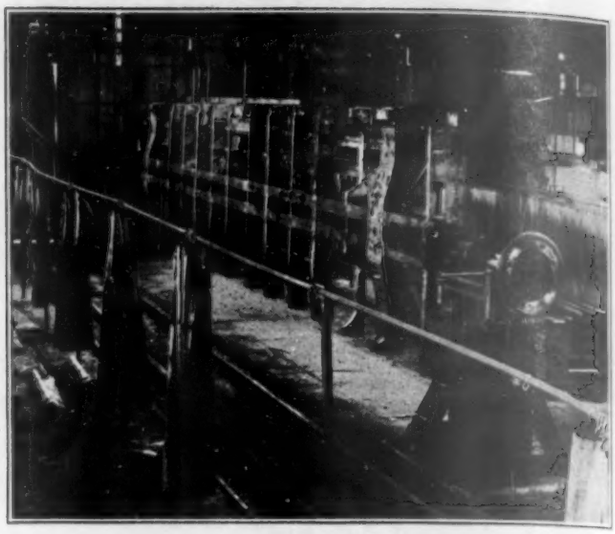
Welded-On Plates Give Protection Against Smoke Corrosion.

This bridge, which spans the Erie railroad tracks at East 34th St., was damaged by heat and corrosive elements discharged from locomotive smokestaks. The stacks clear the bridge stringers by only 6 in., and the corrosive agents had practically eaten through the stringers.

Only by the welding process was it possible to repair this bridge without practically dismantling it and erecting extensive falsework beneath to support the structure while repairs were in progress, stated Mr. Simon, in commenting on the economical advantages of arc welding. The accompanying illustrations offer graphic explanation of the method and manner of the repairs to the span.

Old, badly corroded portions of the stringers were chipped away to expose sound metal. Lengths of steel plate were then inserted between the stringers, welded in place and the openings filled in with weld metal. After the stringers were welded up, smoke plates were welded to the top and bottom to protect the stringers from further corrosion. A total of 500 ft. of welding was required, consisting of 200 ft. of overhead welding (on the underside of the stringers), 200 ft. of downhand welding (on the upper side), and 100 ft. of miscellaneous work. All welding was done with electrodes and welding machines supplied by The Lincoln Electric Co., Cleveland, Ohio.

Work on this bridge was seriously handicapped by passing trains. In order to prevent accidents, it was necessary for one man to stand by and warn the welders (working from ladders) of approaching trains. So great was the force of locomotive exhausts that welding cable, wire brushes, etc. had to be tied down. In spite of these obstacles, the bridge was open to traffic at all times and the work completed ahead of scheduled time.



Underframe in Trunions, Where All Finished Welding Takes Place.

Welded Underframes

in New Lehigh Valley Cars

■ By JOHN E. TESSEYMAN
Sales Engineer, Bethlehem Steel Co.

WELDED underframes constitute a recent improvement that has been embodied in the design of 70-ton drop-end gondolas purchased by the Lehigh Valley Railroad Co. Out of a total of 250 cars that were recently built by the Bethlehem Steel Co. at its Cambria plant at Johnstown, Pa., 135 were equipped with the improved type of welded underframe. Of this number 125 cars are of the conventional type and 10 have the cushion-type of underframe, illustrating the adaptability of welded fabrication to either type. In all other respects the completed cars are of a conventional type, similar to the one shown in the accompanying illustration.

Less Weight and Greater Rigidity

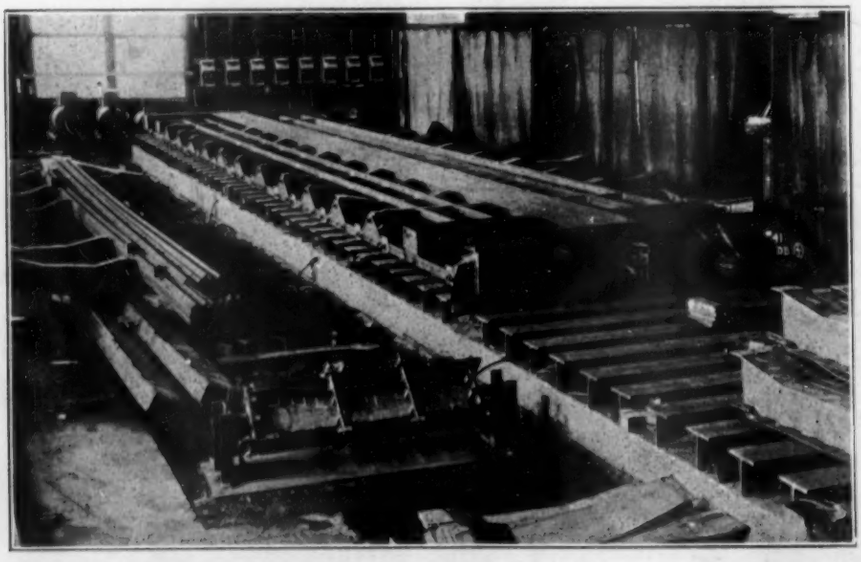
Although no radical changes in the design of the car were occasioned through the employment of the welded underframe, this type of construction brought about a very substantial saving in weight per car, and, as shown by test, the rigidity of the welded structure exceeds that of the riveted type.

Much of the development work in determining the practicability of welded fabrication was carried on at the Bethlehem, Pa., plant, but the final details incident to production were completed at the Cambria plant inasmuch as it is the center of activities for the building of freight cars.

Some time prior to the building of these Lehigh Valley freight cars welding was employed in the fabrication of underframes and pilot cars at the Bethlehem plant; and of the various tests made on the finished structures, the loading test shows less deflection for the welded type as compared to the riveted type of underframe. Other tests made on the welded members show that the strength of the weld is equivalent to that of the parent metal. To date, these pilot cars have been in continuous use over periods ranging from nine months to two years, giving satisfactory service, which demonstrates the practicability of welded fabrication.

This ground work was a necessary expedient which insured familiarity with every component part of the underframe and was productive of methods for handling them on a mass-production scale. In addition, it permitted the ironing-out of seeming difficulties encountered in the welding operations, and was responsible for the sequence of operations best suited to the function of welding.

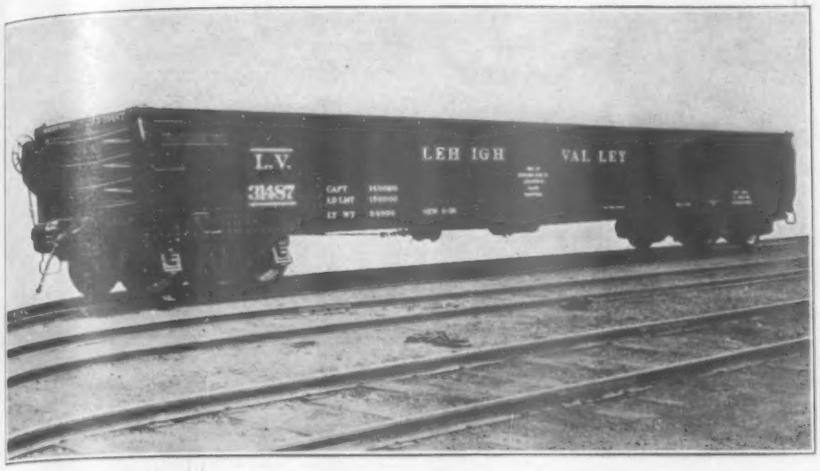
Inasmuch as freight cars are completely fabricated at the Cambria plant, the introduction of the welded underframe structure necessitated special facilities for its manufacture. Additional space was made available where these activities are centered, and a school was instituted where experienced welders became proficient in the type of weld best suited for the purpose, and familiar with all materials to be assembled in accordance with a definite sequence of operations. To further expedite the fabrication of these welded underframes equipment was installed which, in general, includes a surface table 210 ft. in length, made up from 8-in. I-beams laid parallel on a concrete foundation; necessary jigs; pantograph flame-cutting units, and special trunions in which to suspend the underframe assembly during the finish-welding operations.



Underframe Being Assembled on the Surface Bed, Which Also Serves as a Jig to Hold the Component Parts in Place While Being Tack Welded.

Sequence of Operations in Making Underframe

In fabricating a welded underframe, the first operation consists of setting up some of its component parts on the surface table which, in itself, is a type of jig in which the center sill, striking castings, separators and body-bolster center braces for this type of car are placed in position. These parts are here merely tack welded in place, after which the assembly is moved to the next bay, where the horizontal surface welds are completed.



The Welded Underframe of This Drop-End Gondola Resulted in Less Weight With Equivalent Rigidity.

From this bay the assembly is moved to the next position for cambering and cover plating. After these parts are skip welded, the assembly is moved to its next position for fitting the necessary crossties, bolsters and end sills to the center sill and tack-welding them in place. Before the assembly is moved from this bay all floor supports are also tack-welded in position.

Assembled Frame Turned to Permit Downhand Welding

Up to this point all welding operations are confined to plane surfaces that are parallel to the surface table, so as to permit finish-welding operations to be carried on in a horizontal plane. The underframe assembly is now suspended between trunions, whose shafts are extended into the openings of the coupler striker castings. While in these trunions, the underframe section is revolved by means of a hand-powered worm drive on the one trunion so that the welders may perform their work with the section to be welded brought to a horizontal position.

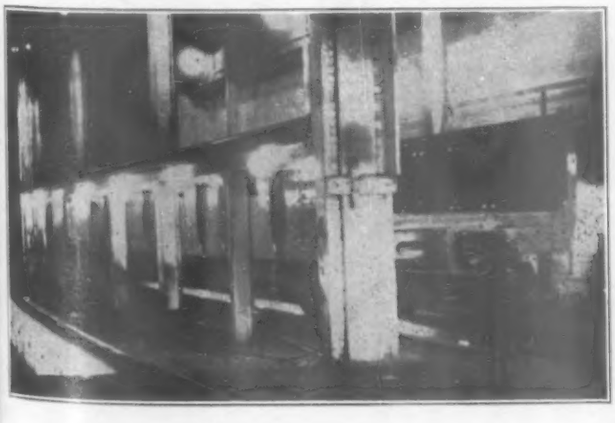
When this welded assembled section is removed from the trunions it is a completely welded underframe which is then taken to the car-erection shop, where it is equipped with the necessary brake-rod, air-cylinder and reservoir supports, which are also welded in place.

To complete the car, the body is attached to the welded underframe before it is put on its trucks. The floor decking is then installed, and when painted, properly stenciled and passing inspection, it is ready to go into service with its saving in weight, occasioned by its welded underframe, converted into payload economy, without sacrificing the strength inherent in the materials from which it was made.

Philadelphia Section to Have Lecture Course

A lecture course, free to members of the Philadelphia Section of the American Welding Society, has been arranged by the Executive Committee of the Section. The names of the lecturers will be announced shortly, and the subjects and dates are as follows: Nov. 6th, Qualifying and Check Testing of Welding Operators; Dec. 4th, Selection and Inspection of Materials; Dec. 11th, Design, Layout and Preparation for Welding; Jan. 8th, Organization and Welding Technique, and Feb. 5th, Inspection and Tests. All lectures will be held at 8 p. m. at the Engineers Club, 1317 Spruce St.

H. C. Snyder, of the Metal Welding Co., Allentown, Pa., is scheduled to speak on "Management and Profits in Welding," at the meeting of the Philadelphia Section on the evening of Sept. 16th.



Welded-Underframe Car, Complete With Accessories, in the Paint Shop for Make-Up and Stenciling.

Completes Large Job on Stacks and Flues

One of the largest welding jobs ever undertaken in Kansas City, Mo., is said to be the new Liquid Carbonic Co. plant, welding on which was done by Camp and Luthy Welders, Inc., 1920 Baltimore Ave., Kansas City, Mo.

The second stage of the job, now completed, consisted of the welding of a series of 24-in. 10-gauge steel flues and stacks. There are two flues over 100 ft. high on each of the welded steel towers, two 37-ft. stacks, and a series of flues connecting the boilers, scrubbers, and blower.

Fabricating was by arc welding, two electric-driven machines having been used on the job. All breaching and four dampers on the stacks and flues were also arc welded. Mr. Camp estimates that, including the towers, he used over 1000 lb. of rods altogether.

"There is only a negligible amount of bolt joining being done on the whole installation," states A. L. Ramp, master mechanic for The Liquid Carbonic Co., Chicago, Ill., who supervised the installation of equipment on the new Kansas City plant.

"The first all-welded job I put in," he continued, "was in our dry-ice plant in Los Angeles in 1930. Previous to that, even with careful sweating together of joints, we were always troubled with leaks in our plants. Since going over to welding, trouble from this source has practically been eliminated.

"In fact, we are so sold on it that every new installation we have put in since 1930 has been all-welded, all replacements on old jobs are all-welded, as are all our brewing equipment, soakers, bottle washers and the like being turned out at our Cleveland factory, where 25 welding machines are used in fabricating these units.

"Our main Chicago plant, with a capacity of 3,600 lb. of dry ice an hour, is an all-welded installation. This plant here will be largely so from the 300- and 250-hp. boilers to the 36 one-ton ice-storage boxes, and even to the bar joists you see up there under the roof," Mr. Ramp explained.

"All the high-pressure liquid lines and the low-pressure gas lines in this 1,400-lb.-per-hour plant will be welded, and except where the manufacturers of the units such as the 500-hp. engine, the 1,200-lb. three-stage compressor, and the 300-ton hydraulic press, have used bolts, all connections, joints and fabricating will be made with arc welding."

A Consideration of Qualification Tests for "Class 2" Arc Welding . . .

■ By R. B. LINCOLN
Director, National Weld Testing Bureau

MANY welders do not seem to realize the necessity of avoiding, what seems to them, trifling defects when welding specimens for the qualification tests under the American Society of Mechanical Engineers' Code for Unfired Pressure Vessels, paragraph U-69 (Class 2), until their specimens fail to meet the test. A better understanding of the problem should result in a considerable saving in the cost of testing by decreasing the percentage of failures.

Some of the factors that contribute to the failure of the specimens are discussed here, and methods of avoiding them are suggested. These are based on the writer's experience in developing welding technic to produce welds complying with the Code, in making welding specimens that passed the test, in training a considerable number of welders, and in "witnessing" the required tests frequently.

Most Frequent Causes of Weld Failure

Experience shows that failure is usually due to porosity or poor fusion, causing rejection of the nick-break specimens under the requirements that they shall show: (a) complete penetration, (b) absence of oxide or slag inclusions, (c) not more than six gas pockets per square inch, and (d) maximum dimension of any such pocket not to exceed 1/16 in.

Porosity or poor fusion may also result in failure of the free-bend specimens, even when the ductility of the sound portions of the weld is well above the Code requirements. If suitable electrodes are used and sound welds produced, there will be no difficulty with the tension specimens.

In the writer's opinion, the soundness of welds made in shops where there is no program of systematic weld testing frequently falls far short of the standard set by this Code. It is difficult to get some men to realize that one small defect may throw out the entire test, and thus cause the waste of the time and money spent in welding, machining, and testing the specimens. A welder will say, "I have been welding for fifteen years and never had a failure." This may be true, and at the same time he may have been frequently covering up defects in his welds that exceeded the 1/16 in. in length allowed in the Code.

Welder Should Feel at Ease

The welder should realize the necessity, and difficulty, in making a weld conforming to the above requirements, both in making the test specimens and in production welding under the Code. On the other hand, there is a danger when welding test specimens of experiencing something like "stage fright" from trying too hard and as a result being so shaky that the specimens are not the best that the workman is capable of producing.

In case the welder finds himself in this condition, the best cure is to weld pieces of scrap, break them, and examine the fracture. When he succeeds in making perfect welds, his confidence will be restored, and he will be ready for the test.

Test specimens must be made of material conforming to the material specifications of the Code. If steel of unknown quality is used, the specimens may fail at too low a value through no fault of the welder. Low-quality steel may contain impurities that, when mixed with the weld metal, will cause gas pockets and result in the rejection of the nick-break specimens. If the test plates are made of steel having higher carbon than the plates to be used in construction, carbon will be absorbed by the weld, lowering its ductility and increasing its strength. This might affect the qualification test favorably or the reverse, but in either case is a violation of the Code requirements.

U-Shaped Edge Is Favorable to Good Welding

The U-shaped preparation is most favorable to securing a perfect weld, particularly for the first bead or layer. All points in the fusion zone are nearly an equal distance from the electrode and receive an equal amount of heat, resulting in uniform fusion. With the V preparation, the lowest part of the V receives the least heat, so that there is a tendency for molten metal or slag to run ahead of the arc and freeze without proper fusion to the parent metal.

The U-shaped groove should have a ¼-in. radius at the bottom if 3/16-in. electrodes are to be used for the first layer, and a 5/16-in. radius for ¼-in. electrodes. The angle of the sides is not critical, but 10° is about correct; if too steep, it will be difficult to avoid undercutting at the upper surface of each layer, and consequent entrapping of slag at this point. If too wide a groove is used so that two or more beads are required to produce one layer, the danger of entrapped slag is increased. The tongue or unbeveled part should be about ⅛ in. thick for 3/16-in. electrodes and 5/32 or 3/16 in. thick when ¼-in. electrodes are used for the first layer.

Preparation for V-Butt Welds

If a V preparation is used without a backing strip, the included angle should be 60°. If beveled to a sharp edge, the edges should be spaced about 1/16 in. apart. If there is a 1/16-in. unbeveled portion at the edge, the space should be about equal to the diameter of the electrode used for the first pass, which should be ⅛ or 5/32 in. When a steel backing strip is tacked to the back of the weld, and afterwards chipped away, the spacing can be a little wider and the included angle decreased.

For 1½-in.-thick plates with a ⅛x1-in. backing strip, the angle may be decreased to 40° included angle (beveled 20° from the perpendicular), and the space increased to ¼ or 5/16 in. for 3/16-in. electrodes. Too narrow a space tends to trap slag under the first layer and cause porosity.

All the major producers of electrodes supply coated electrodes suitable for Code work. The maker should be consulted, because an electrode that has

given very satisfactory results in ordinary welding may not produce welds having the ductility and freedom from porosity required by the Code. Likewise electrodes that are excellent on thin material may not have satisfactory penetration on heavy plates.

Current Should Be Closely Controlled

In order to meet the requirements of the Code, the current must be closely controlled, because the range of adjustment that will produce the best welds is fairly narrow. The electrode manufacturers can usually recommend the exact current needed, but the tables given in their printed instructions sometimes give such a wide range that they leave too much to the judgment of the welder.

Too high a current produces objectionable undercutting at the upper surface of each layer. If this is not chipped out, there is danger of slag inclusions

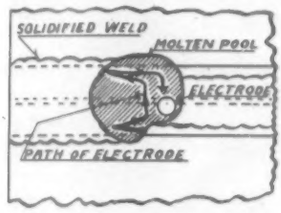


Fig. 1. Path of Electrode When Welding Downhand.

when the next layer is deposited. High current also causes boiling of the metal and leaves gas pockets in the weld. The stub of the electrode gripped in the holder should not be red hot when the electrode is finished. However, in using ⅛-in. or 5/32-in. electrodes on plates 1 or 1½ in. thick, it is sometimes necessary to consume about half the electrode and change to a cold one, allowing the other half to cool before it is used up. This is because the current required to get satisfactory penetration for the first layer is too great for the diameter of the wire.

Too low a current results in poor fusion, entrapped slag, and gas pockets. In the writer's experience, more welders fail from using too little current than from too much.

Defects in First Layer May Affect Subsequent Layers

There seems to be a tendency to think that the first layer is not important because much or all of it will be chipped out before welding the other side. This is not advisable, because experience has shown that gas pockets and slag inclusions in the first layer may produce defects in the subsequent layers. The writer has seen gas pockets that could be traced through three layers. As the arc approaches a defect beneath the surface, the heat causes the entrapped gas to expand. When the solid metal wall between the defect and the molten pool is finally melted away, the gas tends to escape, but sometimes the metal freezes before all the gas escapes, extending the defect into the second layer.

Special care must be taken to avoid inclusions when breaking and restarting the arc. The arc should be broken by drawing away the electrode just fast enough to avoid a deep or porous crater. If it is drawn away too fast, slag is trapped in the crater, and if too slow the metal deposited through the long arc will be of inferior quality.

The best way to start the arc with a new electrode (in the writer's experience) is to strike the arc while the slag on the crater is still molten. It should be started about ¾ in. ahead of the crater and quickly moved back, with a small circular motion, into the craters. After a little practice the arc can be carried just far enough to avoid either a low or high spot. If the slag on the crater becomes black before the arc can be restruck, it should be chipped away. If the crater boils and throws out a shower of sparks after the arc is broken, it is a sign of too much heat, which may be caused by too high a current or by the plates becoming too hot due to too continuous welding on the comparatively small plates.

Weaving of Electrode to Get Uniform Penetration

The purpose of weaving is to distribute the heat so as to get uniform penetration at all points. Little or no weaving is needed for the first layer, but moving the end of the electrode in a small circle sometimes helps to control the slag. As additional layers are deposited and the groove becomes wider, a side-to-side motion is necessary. The arc should be moved along the "shore

Fig. 2. Cross-Sections of Welds.
(A—Good weld. B and C—Not enough heat at edge. D—Defect. E—Undercutting.)

line" of the molten pool so that it plays half on the pool and half on the unmelted metal.

Since the plates tend to draw more heat away from the sides than from the center of the weld, it is necessary to direct the arc more on the sides than the center to secure perfect fusion at this point. The electrode may be paused at each end of its travel, or it may be moved back along the fusion zone as shown in Fig. 1. The electrode is shown when half way across its path, the arrows indicating its path, and the shaded area the molten pool.

The edges of the molten pool should be drawn up the sides by the attraction of the solid for the molten metal. After cleaning, the top surface should be quite smooth and have the shape shown at *A* in Fig. 2. If the edges turn down like water on an oily surface, as shown at *B* or *C*, it indicates that not enough heat was applied at that point. If such a condition occurs, that portion of the weld must be chipped out with a round-nose chisel before the next layer is applied, otherwise the next layer will contain a defect as shown at *D*. In case either or both sides are undercut as shown at *E*, this must be opened up

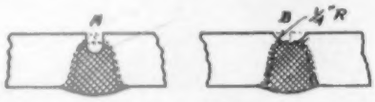


Fig. 3. Root Should Be Chipped Out Wide.

by chipping, so as to permit access of the arc before depositing the next layer.

The slag should be allowed to cool to the brittle stage before removal. It is then broken up with a chisel or scaling hammer, and the layer is wire-brushed. Any slag inclusions, undercuts or other defects should be chipped out with a round-nose chisel so as to permit the arc to reach all surfaces.

Before any welding is done on the back or second side, all defective metal at the root must be removed. A frequent cause of trouble is illustrated at *A* in Fig. 3, where the back is chipped out so narrow that the arc plays on the side but does not fuse the bottom of the groove. If the first layer on the second side is to be made with 3/16-in. electrodes, the groove should be chipped to approximtely a ¼-in. radius as shown at *B*, and for other sizes in proportion to this.

A weld deposited in layers (in the flat position) is less likely to contain slag inclusions than one deposited in narrow beads. The correct thickness of layers will differ with different makes of electrodes. It is important that the pool should be drawn forward by the melting of the forward edge, and that the molten metal should never flow or be forced by the pressure of the arc onto the unmelted surface. Slag should not be permitted to run ahead of the arc. Layers that are too thick are likely to result in slag inclusions and defective fusion while those that are too thin are likely to entrap gas. Lacking more definite information about the particular electrode used, it is a good plan to start with a layer about ⅛ in. thick, that is, 7 layers for a ⅝-in. plate with reinforcement on both sides.

Meeting the Problem of Magnetic Blow

Since 2 in. of the test plate is discarded at each end, magnetic blow is of no

importance at that point, but it sometimes extends for several inches into the weld. Usually a plate on a "grounded" iron table will give more trouble than one supported on wood with the ground connection placed on the top side near the electrode. In welding the side seams of pressure vessels, small pieces of scrap should be tacked on each end so as to extend the weld 2 in. beyond the seam. This is cut off when the weld is finished.

Magnetic blow can be partly cured by tilting the electrode so that it leans to the "blow" as shown at *A* and *B* in Fig. 4. The normal position is shown by broken lines, the direction of the "blow" is indicated by the curved arrow,

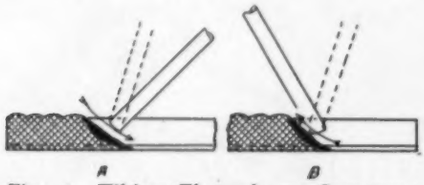


Fig. 4. Tilting Electrode to Counteract Magnetic Blow.

and the corrected position of the electrode by full lines. Sometimes the "blow" is much worse in one direction than the other, so that the trouble can be corrected by welding in the opposite direction. It is usually safer to weld in the direction of the blow than against it.

Battery Chambers Protected From Acid by Sprayed Lead

By S. JOHN OECHSLE
President, Metalweld, Inc.

A metal-spraying contract recently completed by Metalweld, Incorporated, of Philadelphia, Pa., for the Peruvian Government, is of particular interest because it served to prove the ability of sprayed metal coatings to withstand acid corrosion over a period of years. This particular application consisted of spraying the battery chambers of two submarines with lead to protect against sulphuric acid and its fumes.

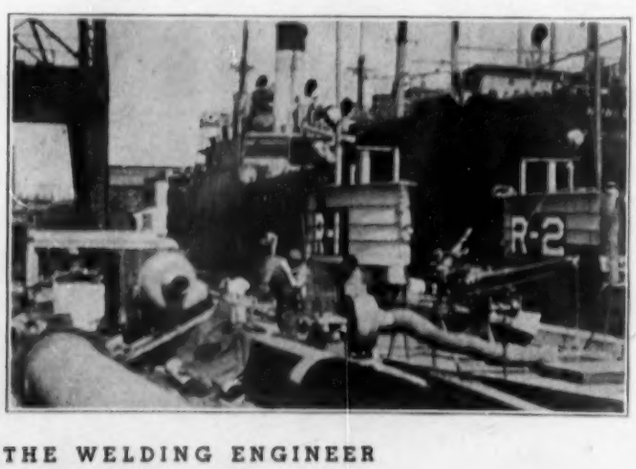
These submarines, the property of the Peruvian Government, were built by the Electric Boat Co., of Groton, Conn., approximately ten years ago. At that time the entire battery chambers were sprayed with lead to protect the metal against acid and fumes, this being done more or less as an experiment to determine whether sprayed lead coatings would successfully resist sulphuric-acid corrosion. Time has proved the success of the experiment.

The submarines made the trip from Peru to Philadelphia in June for the purpose of having new batteries installed. When the batteries were removed at Cramp's Shipyard, it was noticed that the sprayed lead coatings, after ten years of service, were practically intact on the four sides of the battery compartments. The floors of the compartments, however, showed slight evidence of pitting. The officers in charge of the submarines decided to renew the lead coatings on the floors of the submarines, there being no other practical method of applying lead to the floors of the compartments. Metalweld, Incorporated, who have had long experience in handling metal-spraying contracts, were awarded the contract to perform this work.

There were two compartments in each submarine, each 8 ft. wide by 16 ft. long, and it was decided to spray a lead coating 1/32 in. thick on the floors. The compartments were first thoroughly blasted with steel grit and then sprayed with lead, approximately 2,000 lb. of the metal being used. After this work was completed the sprayed surfaces were coated with a bakelite varnish.

Portable air compressors were placed on the dock for furnishing air for sandblasting the compartments, also a portable motor-driven ventilating system was rigged up to furnish the necessary ventilation. The only means of obtaining ventilation in the battery chambers was through two hatches, one on each end of the compartment. The ventilating system was arranged so that fresh air was drawn through the other hatch. The fans that were used to suck fresh air into the battery chambers were of sufficient capacity to change the air in the tanks approximately five times per minute. The sprayers were compelled to wear a complete rubber suit to protect their skin from lead dust, and each man wore a gas mask fed with air from the compressors. The work was carefully planned and followed through on a schedule of two shifts, working approximately 8 hours each, 16 hours per day.

Time was an essential factor on this contract, as there was only a few days' intervention between the time the batteries were removed and new batteries installed. Work was scheduled so that while the second compartment was being blasted the first compartment was being sprayed with lead. The work was completed on schedule and accepted by the Peruvian Government as having been satisfactorily performed.



Peruvian Submarine in Dock to Have Battery Chambers Metal-Sprayed With Lead.

Safety Council Program Includes Papers on Welding

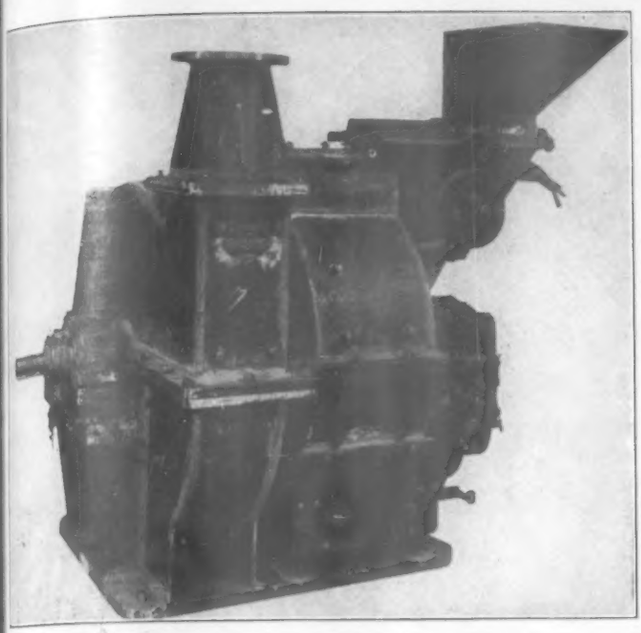
Papers on welding and torch cutting have been prepared for the meeting of the Chemical Section of the National Safety Council at the Annual Safety Congress and Exposition, to be held under the auspices of the Council, during the week beginning Oct. 14th, at Louisville, Ky. Beginning at 10 o'clock on Tuesday morning, Oct. 15th, in Parlors A-B-C, on the mezzanine floor of the Brown Hotel, J. R. Dawson, research metallurgist of the Union Carbide & Carbon Research Laboratories, is to read a paper on "The Welding of Chromium Steels in Chemical-Plant Equipment." At 11 o'clock, a paper is scheduled on "Welding and Cutting in Tanks and Other Small Unventilated Places," by H. F. Reinhard, chemical engineer, Carbide & Carbon Chemicals Corp. Both papers will be followed by discussions.

Welded Unit Equal to Cast One in Appearance

Equipment designed for welded steel construction can be made as attractive as the same product assembled from castings, in the opinion of the Raymond Bros. Impact Pulverizer Co., 1319 N. Branch, Chicago, Ill. The welded coal-pulverizing and firing unit shown in the illustration is an example of how this company uses rolled steel and welds it to make a machine that is every bit as attractive as what one might expect from a cast design.

This unit takes coal crushed to 1-in. size, at the rate of 4,000 lb. per hour, pulverizes it through a hammer mill and then blows it directly into the furnace, where it burns. The unit is 3½ ft. high, 3½ ft. wide, and 5 ft. long, and is constructed of ¾-in. boiler plate. It weighs approximately 10,000 lb. It is welded throughout, bolts being used only on certain parts to facilitate replacement and making of repairs. Hollup "Sureweld" electrodes were used in its construction.

The grinding chamber is lined with ¼-in. plate bolted to the shell of the unit. This lining is readily replaced



Welded Pulverizing and Firing Unit.

and prevents wear of the ¾-in. shell plate.

Weight comparisons with a cast-iron unit can only be estimated, since no similar unit has been made in cast construction, but the Raymond Bros. company finds that equipment constructed from welded steel plate will average about 25% lighter than comparable units built of castings.

Other factors, such as one-piece construction and elimination of patterns, tend to put the margin of saving safely on the side of the all-welded unit.

Shop Handles Large Pipe Job and Makes Tank Repairs

Lately the Superior Welding Co., 331 Knoxville, Peoria, Ill., has been busy welding piping and making tank repairs for the Commercial Solvents Corp. plant in Peoria, as well as welding a gas holder, and doing other interesting as well as important jobs.

The pipe job for the Commercial Solvents Corp. consisted of 1,800 ft. of 12-in. pipe with a 2½-in. steam line, steam valves being placed every 50 ft. This installation is for the purpose of pumping black-strap molasses from barges. The pipe was received in 38-ft. lengths, but the screw joints in the center of each length were found to leak under test, so they also had to be welded. Almost 500 ft. of the line extends over water. On June 17th, the first cargo of 2,817 tons of black-strap molasses was pumped through this line.

Five large seed tanks were also repaired by welding, at the Commercial Solvents Corp. plant, and the Superior Welding Co. also are welding a large gas holder at Peoria's sewage disposal plant, for the Stacey Bros. Construction Co., of Cincinnati, Ohio. Some rivets are also used. Another large holder will be repaired after completion of the new one.

Other jobs recently completed by the Superior Welding Co. include the repair of a large press for Altorfer Bros. in East Peoria, the building of 40 armor-plate steel-bullet catchers ranging in size from 12 to 24 in., making an all-welded truck bed for a soda-pop truck, and welding the steel casing for an 8-in. cast-iron gas line where it runs under four railroad tracks.

Oklahoma Craftsmen Hold Successful Trade Fair

In Weatherford, Okla., population 2417, a two-day "Trademen's Fair," held on Aug. 14th and 15th, ended with a registered attendance of 2033. This show, the first affair of this kind ever held in that section, was organized and promoted by the Western Oklahoma Machinists, Welders and Blacksmiths Association, assisted by the Weatherford business men.

Many manufacturers of equipment held exhibits and demonstrations in the community building in Weatherford during the two days of the fair. The skilled craftsmen comprising the sponsoring association realized that the responsibility of teaching the public the benefits to be derived from their respective trades was theirs, and hence the name "Trademen's Fair." Forty-four of the local business men cooperated with the association by giving prizes and in many other ways assisted in promoting the project and making it a success.

Many took advantage of a general invitation to bring in any broken parts they had, to be repaired by welding without charge to them. Enough work was brought in to keep all the equipment in operation, thus making for lively, interesting exhibits.

Weatherford's "kid" band and an orchestra furnished music at intervals. The high interest shown throughout that entire section has stimulated interest in a proposal to hold another fair next year.

Among the companies exhibiting were the Mee-Oakes Supply Co, The Motor Equipment Co., Van Norman Machine Tool Co., The H & H Chevrolet Co., The Welders Supply Co., Burdett Oxygen Co., Peterson Welding Laboratories, Air Reduction Sales Co., The Linde Air Products Co., Hammett Manufacturing Co., Oklahoma City Hardware Co., Simplicity Manufacturing Co., Severin Tire & Supply Co., Midke Supply Co., Sunnen Products Co., Sioux-Abertson Co., and Storm Manufacturing Co.

The officers of the Western Oklahoma M-W-B Association are: president, J. A. Walling, of Elk City; vice-president, Roy Starr, of Fort Cobb; and secretary, Chas. Kendall, of Weatherford.

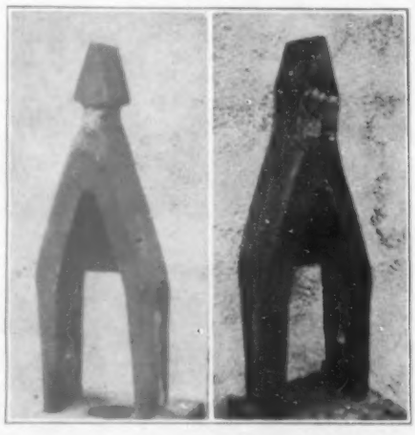
259-Ft. Welded Ship Built for Great Lakes Service

What is reputed to be the largest all-welded ship ever constructed will soon be plying the Great Lakes. It is the *Joseph Medill*, which was launched early in June by Messrs. Swan, Hunter and Wigham Richardson at Wallsend, England. It was built for the Quebec and Ontario Transportation Co., Ltd., of Montreal, for the carrying of pulpwood, newsprint, grain, etc. on the Great Lakes. The vessel has an overall length of 259 ft.

Tipping Teeth With Forged Manganese Wedges

The use of forged wedges for re-tipping worn-down manganese-steel shovel and dipper teeth has a number of advantages over other methods of repair, says B. H. Payne, manager of the Stulz-Sickles Co., 134 Lafayette St., Newark, N. J.

These wedges are of nickel-manganese-steel, being the same composition as the



Showing Wedge Spotted on Tooth, and the Completed Weld.

corresponding welding electrodes. When attached to worn-down shovel teeth they very often withstand impact and abrasion better than a new shovel tooth, owing to the fact that the wedge is a steel forging, whereas the shovel tooth is a casting.

Stop-Explosion Device Has Air-Tight Joints

Electric welding is used by a San Francisco inventor in manufacturing a stop-explosion device, designed to eliminate explosions in containers by preventing flame propagation.

The particular device shown in the illustration is for use in an 8-in. gas pipeline. It includes a double wire-screen basket so constructed within a steel pipe section that the diameter is expanded sufficiently to give a free flow of the gas through it, and at the same time prevents any flame from passing. The small end of the device is of the

Welded Stop-Explosion Device.

same size as the pipeline to which it is to be installed. These devices are available for gas pipelines from ½ to 30 in. in diameter.

Another type of this device is made to be installed in the inlet and outlet of the gasoline supply tank of motor-propelled vehicles, and in the gasoline lines near the carburetor.

To demonstrate the efficiency of this device, the inventor built an electrically welded test tank, in the opening of which he welded one of his stop-explosion devices. He then poured gasoline through the device into the tank, then placed a lighted match near the top of the opening. Immediately there was a blaze, but no explosion. The tank was then picked up and tipped so gasoline ran out of the opening where the flame was, and burned, but still no explosion occurred.

The welded seams produce an absolutely vapor-tight joint, which is necessary to the efficacy of the device.

Longitudinal Welding of Band Saws

Commenting on the welding of saws, Charles H. Bradford, filer of the Big Lakes Box Co. of Klamath Falls, Ore., gives his opinion that some filers perhaps are too enthusiastic over the possibilities and have carried the matter too far. Very few if any filers can say just how far welding can be carried successfully.

"In order to determine what the maximum use of welding may be, I have carried forward some experiments and attempted some jobs which under normal conditions I probably would not have attempted," says Mr. Bradford. "For our own mill, as well as several other mills, I have longitudinally welded band saws.

"The first pair of saws which I welded longitudinally was peaned by hand and was finished in September, 1932. These saws have been in fairly continuous use since that time. They have a tendency to develop cracks in the weld, which is more or less true of all longitudinal welds in saws. But since that time I have installed an air hammer for peaning and am practically free from cracks in the weld, as I find peaning a very important part in welding. These cracks, however, do not take long to weld.

"In longitudinal welding I endeavor to keep the weld line outside of the tension. This, I think, reduces the tendency to crack. I carry the tension in about 8 in. from the face.

"I make a band saw out of six pieces by this method and another with five pieces. In another case I made a saw, using a 3½-in. 14-gauge strip on a 13-gauge blade. This seems to work out well, as I cannot see any difference in the working of the blade.

"I do not think it advisable to weld more than a 3½-in. strip on the back to make a 14-in. blade, because it puts the weld, or soft line, too near the center of the blade, which causes the weld to be more inclined to crack; but by keeping the weld 3½ in. or less (in a 14-in. saw) from the back and carrying, say, a 50% tension in the back quarter, I protect the weld and make it practically free from cracks. I have never had a longitudinal crack.

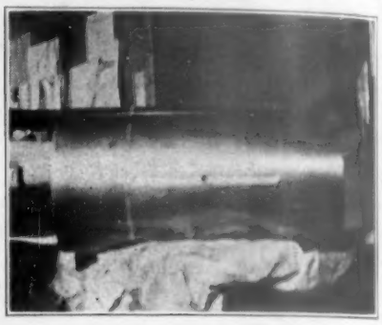
"It seems obvious to me that we can go entirely too far in welding. For example, the work expended and the results obtained by welding too many pieces in normal times would not, I believe, be justified.

"It is always a question of whether the welded saws will stand up and cut as much in a day as a new unwelded saw. The way to determine that would be to run a new and a reclaimed saw together.

"Our mill cuts in excess of 11,000 ft. per hour. Could we, for example, increase our cut 500 ft. per hour by using new saws and discard them before they were very narrow? An additional 500 ft. per hour would very soon pay for a new set of saws. This is a phase of the saw problem which needs study."

Large Savings in Reclaiming Worn Cross-Head Pins

An Ohio gas company was confronted with the problem of choosing between replacing and repairing a worn cross-head pin of a 1,500-hp. gas engine. The pin was subjected to tremendous wear in



600-Lb. Cross-Head Pin After Repairing.

the center portion out to within 4 in. of each end. The wear at times was as much as ¼ in. before starting to give trouble.

Arc-welded repair was decided on. The pin was removed and cut down another ¼ in. to insure reaching clean base material that was not oil-soaked, and the cut was extended ½ in. into the unworn end sections. After machining, beads were laid lengthwise of the pin, and each bead peaned with an air hammer. It was found necessary to pean to prevent the forming of pin holes. One complete layer was made around the pin, each bead being run lengthwise instead of around the pin. The surface was then thoroughly cleaned and another layer applied. This procedure was continued until the shaft was about 3/16 in. oversize. The pin was then machined and finally ground for finish.

Since then, several other pins have been repaired in this manner. These varied considerably in the amount of time and material required. The pin illustrated weighs 600 lb. and took a total of 18 hours, 8 hours of which was for machining. A new pin would have cost $350. Approximately 80 lb. of shielded-arc electrodes was used. Other pins have required as much as 150 lb. of welding wire. It is reported that the pin shown was reclaimed at a total cost of $46, though other pins have run as high as $65.

In addition to the saving in cost over a new pin, the pin rebuilt by arc welding has the advantage of lasting longer than a new one.

What's New in

Equipment and Accessories

Electrode for Building Up Cutting Edges of Tools

"Dieweld," a new electrode for building up worn cutting edges on tools, dies, bits, lathe tools, drills, milling cutters, hot- or cold-forming and cutting dies, shear blades, and like surfaces, has been announced by the Steel Sales Corp., 129 S. Jefferson St., Chicago, Ill. This electrode is said to produce a dense, nonporous weld that withstands severe shock and abrasion. An extruded protected-arc coating shields the metal from the atmosphere during the welding operation, and steadies the arc, at the same time assuring a smooth, uniform weld deposit, it is said. The average deposit made with "Dieweld" will show a hardness of 55 to 65 Rockwell C and has the remarkable advantage of retaining this hardness up to about 1000°F. The electrode is stocked in diameters of 3/32, 1/8 and 5/32 in.

Announces Corta Oxygen-Jet Cutting Machine

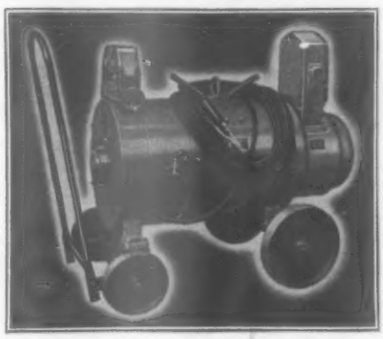
The "Corta" oxygen-jet cutting machine has been announced by the National Cylinder Gas Co., 205 W. Wacker Drive, Chicago, Ill. The design of the machine is such that all the working arrangements, including control handles and levers, as well as the tracing, the template, and the actual cut are in front of the operator within easy sight and reach. Also, the traveling surface of the roller is illuminated, making it easy to follow a drawing accurately. The universal driving motor has a stepless speed control, and a speedometer shows the actual rate of advance in inches per minute. The traveling and guide rollers are electrically driven.

The roller can be guided by hand for following the lines of any shape laid out on the work or for following the lines of a drawing. Automatic control can be obtained by using a template or in the cutting of circles or straight lines. The torch can be adjusted to make bevel cuts.

The Corta Machine Torch Makes It Easy to Watch the Work and Control the Machine at the Same Time.

Announces Improved Line of Heavy-Duty Arc Welders

A newly improved line of heavy-duty arc welders has been announced by the Harnischfeger Corp., 4513 W. National Ave., Milwaukee, Wis. The most important changes and refinements include the new oversize, two-bearing armature shaft, removable ball-bearing capsules, more simplified single-current control, dust-proof calibration plate, heavy-duty built-in polarity switch and dripproof housings.



200-Ampere, Heavy-Duty Welder.

The illustration shows the new 200-amp. machine, which retains the previous P&H-Hansen generator design with the patented internal stabilizer coils embedded in the main pole tips, unique short-circuit winding and magnetic bridge, which result in a broad welding range and a high degree of current uniformity. The general outward appearance of the 300- and 400-ampere units is identical.

The motors have solid cast frames with top opening for terminal leads and mounting of the magnetic switch-type starter. The unit is equipped with no-voltage release and overload protection. A constant flow of cooling air, circulated by the large aluminum fan between the motor and the generator, is discharged at the end of the all-welded generator housing. Connections are available for standard or special voltages of 2 and 3 phase, 60 and 50 cycles. Gasoline-powered units in a wide variety of stationary and portable mountings also are included in the new line.

Cycle Recorder for Use With Resistance-Welder Timers

A new cycle recorder, a device for giving pictorial evidence of the length of time current flows in an a.c. circuit, is available from the General Electric Co., Schenectady, N. Y. This cycle recorder is designed for use with resistance-welder timers, in calibrating or adjusting these timers or as a means of producing a permanent record of a weld time. By indicating when an accurate re-setting of welding time is attained, the new device is very useful in duplicating welds previously found to be satisfactory. The instrument therefore not only records optimum welding time for a specific job as determined by experiment, but enables the production-welding machines to be easily and quickly set to reproduce this time. It furnishes a check on the proper functioning of welder timers, and is of assistance in locating the cause of spoiled work.

New Device Records Cycles of Duration of Current Flow.

The new device records, on a strip of paper, the cycles of duration of current flow. It is oscillographic in nature, but no attempt is made in its design to make it follow the wave form accurately. It consists of a compact unit, 5½x7½x7½ in., containing a frequency-responsive element, marking mechanism, paper-tape drive, and paper-tape supply.

The frequency-responsive element is a polarized reed driven by a coil which surrounds it. This driving coil is tapped for use at either one or five amperes, although a 110-volt coil can be obtained if desired. The reed vibrates and follows the alternations of the current.

The recording device is inkless and simple. A stylus carried by the vibrating reed presses very lightly on a moving strip of very thin paper, under which rotates a graphite roll. The paper is so thin that the record can be read from either side of the strip. A 2000-ft. roll (one loading for the cycle recorder) is only 5 in. in diameter. The paper is, nevertheless, tough and permanent. Both paper and graphite roller are readily renewed. A small a.c. motor drives both the graphite roll and the recording tape.

The entire device is so simply and sturdily built that it is well suited for field use, and the manufacturer claims that very little skill is required to apply and operate it.

Air-Gas Torch Burns Natural Gas and Other Fuel Gases

A new air-gas torch, known as the Torit No. 26, may be used with various kinds of gases such as natural gas, manufactured city gas, butane, propane, etc., in connection with compressed air. It is said to be positively leak-proof, and so designed that the gas and air are thoroughly mixed, which is necessary for highest efficiency. In order further to increase the efficiency, two tips are supplied instead of only one—a feature particularly desirable when natural gas is being used. The torch is recommended for soldering radiators and for all sorts

Soldering Torch That Burns Natural Gas.

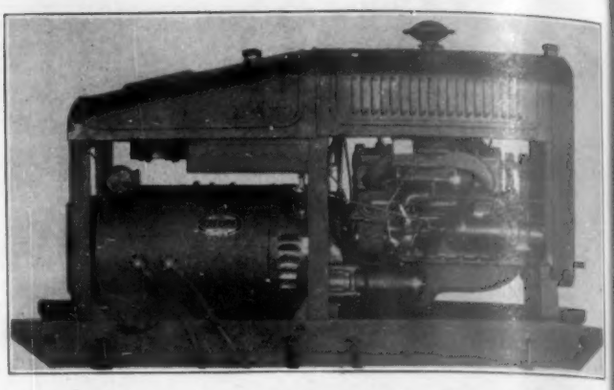
of work that can be done with an air-gas flame. Further particulars can be obtained from the manufacturers, the Torit Manufacturing Co., 174 W. Kellogg Blvd., St. Paul, Minn.

Gasoline-Driven Welder Has Remote-Control Feature

A new type of remote control in conjunction with a new gasoline-driven arc-welding unit was recently announced by the J. D. Adams Co., Indianapolis, Ind.

The welding unit, available in 200- and 300-ampere sizes, is directly connected to a sturdy 4-cylinder, high-torque gasoline engine. The entire unit is mounted either on steel skids or on a 4-wheel trailer with either rubber-tired or all-steel wheels.

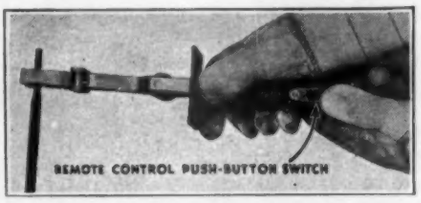
The battery, generator, starting motor, automatic choke, automatic speed governor and the new Adams remote control



New Welder Can Be Started and Stopped From Special Electrode Holder.

are all furnished as standard equipment.

The remote control feature is obtained from an electrode holder with a special tumbler switch mounted in the handle, the operation of the switch starting and stopping the gasoline engine without the necessity of running back to the machine. With this ease of control always



Electrode Holder With Remote-Control Switch.

at the operator's finger tips, the idle running of the engine is eliminated, with its resultant wear and crankcase dilution.

New Aluminum Welding Flux Announced by Braz-Weld

A new flux for electric and torch welding cast and sheet aluminum as well as all aluminum alloys, has been announced by the Braz-Weld Co., 2844 California Ave., St. Louis, Mo., and is known as the Braz-Weld Aluminum Welding Flux. This flux is said to eliminate any need for cleaning or sanding before welding. It works easy, according to the claims of the manufacturer, who is offering free samples to those working with aluminum.

Straight-Polarity Electrode of Shielded-Arc Type

A new shielded-arc straight-polarity electrode, known as "Superweld No. 77," has been announced by the Steel Sales Corp., 129 S. Jefferson St., Chicago, Ill. The nature of the coating is such that the electrode can also be used with reversed polarity. Hence, in whatever polarity the machine happens to be set, "Superweld No. 77" handles easily and produces strong, ductile, corrosion-resistant welds.

The protective slag is very friable and hence easily removed by merely brushing, making this electrode particularly suitable for multi-layer welding.

"Superweld No. 77" can be used in all welding positions and for both light and heavy work. It comes in sizes of 1/8 to 3/8 in., and is packed in 50-lb. containers.

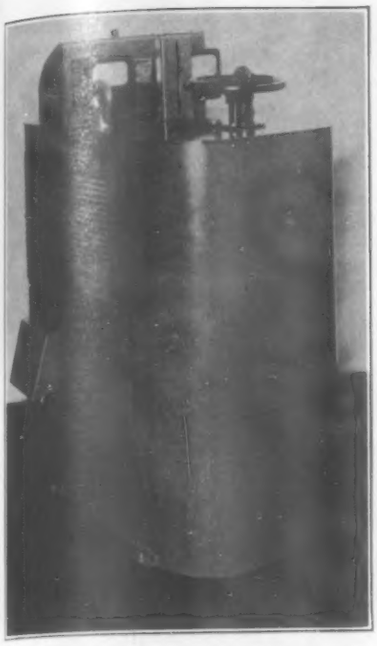
Weld metal deposited from "Superweld No. 77" under actual shop conditions is said to have the following physical properties: ultimate strength, 70,000 lb. per sq. in. minimum; yield point, 50,000 lb. per sq. in. minimum; elongation in 2 in., 20% minimum. A recent test on a 0.505-in. all-weld-metal specimen showed a yield point of 70,800 lb., 30% elongation in 2 in., and 45% reduction in area.

Transformer-Type A. C. Welders in Three Sizes

Two new a.c. transformer welders of the single-operator type have just been announced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., and will be displayed at the company's booths, No. B-15 and C-16, at the National Metal Show in Chicago the week beginning Sept. 30th.

One of these units is rated at 500 amperes, with a welding range of 100 to 500 amperes. It is equipped with automatic control to cut the machine off the

Westinghouse A. C. Welder Gives Range of 30 to 150 Amp. and Weighs 230 Lb.



New 500-Amp. A. C. Welder.

line when the operator stops work. The machine is brought back on the line by a momentary contact made by a switch in the electrode holder.

The other unit is smaller, having a range of 30 to 150 amperes. It weighs only 230 lb. and is available for primary voltages of 110/220 or 220/440.

Instrument for Measuring Changes in Volume

E. Leitz, Inc., 60 East 10th St., New York City, has placed on the market the Leitz Dilatometer "HVT," for determining volume or other changes in metals and alloys as they are being heated, and with which can be determined coefficients of expansion and the exact temperature at which these metals have critical or transformation points.

The new dilatometer, which will be exhibited at the National Metal Exposition, is a self-contained unit, complete in itself. It employs a furnace in which the specimen under investigation is being heated simultaneously with a standard of predetermined properties. Quartz rods transmit the expansion of the two metal pieces onto a reflection prism. A very fine beam of light coming from a powerful light source falls upon this prism and is reflected onto a ground glass or a photographic plate where it appears as a very small light spot. As the specimen is heated, this light spot records on the photographic plate the minutest changes in volume as a function of the temperature. It is possible to determine very accurately the actual change in length for every range of temperature and these photographic records indicate very precisely those temperatures at which the transformations occur.

This dilatometer reacts on a pressure of 10 to 12 grams on the quartz rod. This fact makes the instrument particularly usable for the determination of properties of expansion of light or soft metals which would easily bend if they had to overcome too great a pressure.

The instrument permits determination in vacuum, so that the influences of oxidation during the process of heating can be completely eliminated. Also, it is equipped with a special device for cooling experiments. Because of its simple operation, no special training is required.

Device Has Sure Grip for Lifting Plates and Piling

For the safe handling of steel plates, columns, piling, and similar material, the "Grip Lifter" has been developed by the Shaw-Box Crane & Hoist Co., Inc., Muskegon, Mich. The manufacturer claims that the sure grip of the device makes it impossible to release the material as long as it is suspended. The load must be

"Grip Lifter" for Handling Plates and Other Material.

placed on the ground, and then it can be released by pulling on the trip rope. A bulletin describing the "Grip Lifter" is available.

Metallic Coating in Powdered Form for Touching Up Spots

"Amco Metallic Coatings" are now furnished in a powdered form that requires only water being mixed with it, says the American Solder & Flux Co., Wayne Ave. and Berkley St., Philadelphia, Pa. These coatings were formerly supplied only as a separate metal and flux.

In their new form, the metal coating solutions are applied to the metal surface to be coated, and are then heated to the melting point of the coating, which is between 356° and 500°F., depending on the brand of coating used.

The coatings are available in zinc, tin and lead. The zinc coating is comparable to hot galvanizing, the tin is generally used in the preparation of food products, and the lead coating is used as a protection against acids and various fumes.

These coatings are said to be ideal for touching up spots that have not been properly coated, or where welding or brazing has burnt the original coating away. In such cases it is only necessary to clean the surface to be coated and then apply the desired brand of coating, either mixed with water or in powdered form.

Acetylene Generators in 30-Lb. and 50-Lb. Sizes

Portable acetylene generators, known as Type D, in 30-lb. and 50-lb. sizes, carrying the approval of the Underwriters' Laboratories, have been developed by the Smith Welding Equipment Corp., 2619 Fourth St. S. E., Minneapolis, Minn. It is pointed out that the Underwriters' approval is a "double rating," which means that, without being overheated or overloaded, the 30-lb. Type D generator is rated to deliver a maximum of 60 cu. ft. of acetylene per hour, which volume is sufficient to operate one large-size welding tip or two medium-size welding tips, and that the 50-lb. generator is rated to deliver a maximum of 100 cu. ft. of acetylene per hour, thereby taking care of the largest tip a welder may desire to use or supply acetylene for three medium-size welding tips at the same time.

These generators can be easily mounted on a truck, trailer or hand cart and held in place by U-bolts fitted through holes in the base of the generator.

The feeding of carbide from the hopper into the generator is controlled by the action of an 8-in.-diameter diaphragm and a coil spring in the top of the carbide hopper. By simply turning

New "Smith" Acetylene Generator.

the screw in the top of this hopper, the operator can easily and quickly regulate the pressure at which acetylene is generated. Provision is made for locking the feed mechanism when the generator is being moved or is not in use.

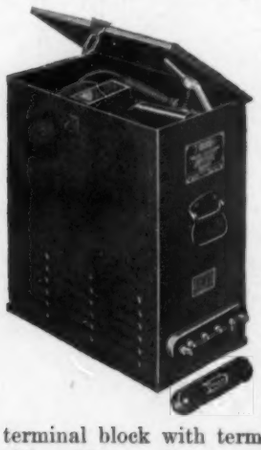
The 30-lb. generator has a 21-in.-diameter shell, is 55 in. high, and has a net weight of 119 lb. The 50-lb. unit has a 24-in. shell, is 65 in. high, and weighs 145 lb. net.

"Donganarc"—A New A. C. Transformer-Type Welder

"Donganarc" is the trade name of a new a.c. welder of the transformer type that has been developed by the Dongan Electric Manufacturing Co., 2987 Franklin St., Detroit, Mich. It will handle coated electrodes ranging from 1/16 to ⅛ in. in diameter.

The unit is completely housed in a steel case having a durable baked enamel finish. The case is equipped with a separate compartment suitable for containing the welding shield, electrode holder, leads, tools, etc.

The line connections are made to the welder by means of a specially designed

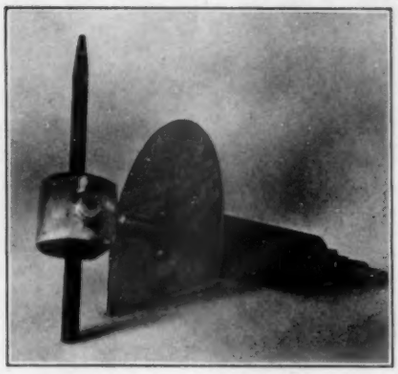


A. C. Welder With Separate Compartment for Electrode Holder and Other Accessories.

terminal block with terminals such that either 110- or 220-volt service may be used. The terminal block is mounted on one end of the case, and the switch and output terminals are on the opposite end; thus the line terminals are kept away from the output leads. The manufacturer emphasizes the ease with which the arc can be struck and maintained with this welder.

Water-Cooled Holder for Carbon Electrodes

A carbon-electrode holder, designed for welding and cutting with the carbon arc, has been developed by Colmonoy, Inc., of Los Nietos, Calif. It is furnished complete with adapters to fit carbon diameters of ⅝, ½, and ⅜ in. A hollow fiber handle is designed to slide back to cover the water connections. The holder also is equipped with a copper shield and with a water-cooled aluminum head having brass piping through the handle to join the water connection with



Electrode Holder Has Copper Shield and Water-Cooled Head.

the head. The carbon is held in place by a long wedge. This holder is said to derive its particular efficiency through the fact that the welder may stay close to his work, yet the holder remains cool.

Makes Easy Cleaning of Stainless-Steel Welds

"Brightboy" Light Abrasive Tablets, described as a development in the science of compounding rubber and abrasives, are being manufactured by the Weldon Roberts Rubber Co., Newark, N. J., for cleaning welds on stainless-steel products and removing heat marks. The soft rubber binder cushions the abrasive. Its action is said to be rapid, permitting quick cleaning.

"Brightboy" is made in convenient bias shape in two stock sizes—2 3/16 in. long, 1⅛ in. wide and in ⅜-in.and ¾-in. thicknesses. It is also being made up in a number of special sizes to meet particular requirements. Samples are being offered to all interested firms.

A. C. Welders Operate From 220-Volt Circuit

Three sizes of transformer-type a.c. arc welders have been announced by the Franklin Transformer Manufacturing Co., 607 22nd Ave. N.E., Minneapolis, Minn. They are designed to operate from a 220-volt a.c. single-phase circuit,

New "Franklin" A. C. Welder.

and employ an automatic feature that is said to make it easy to start and maintain the arc without any previous experience on the part of the operator. From 7 to 9 heat stages are provided, allowing a wide variation in welding range.

The Model 100 welder is said to have a secondary range of 10 to 125 amperes, with a current consumption of 3½ kw., using rod of 1/16 to ⅛ in. in diameter. The Model 140 unit, also with a secondary range of 10 to 125 amperes, has a capacity of 4½ kw., and handles rods up to 5/32 in. in size. The largest size, known as Model 170, is recommended for heavy work; it has a secondary range of 37 to 265 amperes and a current consumption of 7½ kw., and is said to be able to handle electrodes of sizes 3/32 to ¼ in.

Announces New Method for Making Clad Steels

By means of a new process, it is claimed that any high-alloy steel that is capable of being forged can be welded to a low-alloy steel or mild-steel backing, or to any alloy steel, making a composite sheet or plate. Announcement of this process has been made by the Latrobe Electric Steel Co., 40 West 40th St., New York, N. Y. This method of making clad steels is known as the "Duo" process, and the resulting products are known as "Duo-Metals."

In applying the process, first the surface of the high-alloy steel is chemically

Sample of Duo-Metal Bent Double.

cleaned of oxides or non-metallic materials, and then the steel, with the surfaces maintained chemically clean, is immersed in an iron electroplating bath, where the surface of the steel has deposited upon it a film of electrolytic iron. The steel is then heated, without pressure, to about 1700°F. for about an hour, which treatment is said to produce an excellent diffusion weld between the electrolytic iron and the high-alloy steel. The backing metal is also often electroplated in this manner.

Now, since the high-alloy steel and the backing steel both have an exposed layer of pure iron, the placing of one upon the other and heating to about 2000° to 2100°F., with pressure applied by hammering or rolling, produces a weld between the two surfaces which is said to improve in strength when subsequently heated, due to the diffusion of one metal into the other. Photomicrographs of Duo-Metals show a complete absence of any non-metallic material or inclusions, it is said, and furthermore, the claim is made that the joint between the two metals is very strong.

By this process, high-alloy steels such as non-corrosive steels (including 18-8

Mr. Charles Gallo. He praises Tobin

J. L. WHITE & CO., Inc.
Electric Arc and Oxy-Acetylene Welding Cutting, Welding Supplies
Equipment, Oxygen and Acetylene Gases, Carbon Burning
44 North Elm Street — Waterbury, Conn.

August 6, 1935.

American Brass Co.,
Waterbury, Conn.

Gentlemen:

We have used Tobin Bronze since the days when bronze welding was practically unknown...and we still use it. Our men prefer Tobin Bronze because it is so uniform. When a man welds with Tobin Bronze, he doesn't have to keep changing his methods to make up for variations in the filler rods. In all our experience, we have never known Tobin Bronze to vary in the slightest degree...and when we send a Tobin Bronze weld out of our shop, we know it will give satisfaction.

Yours truly,
CHARLES GALLO
J. L. White Company, Inc.

"Our men prefer TOBIN BRONZE because it is *so uniform*"

PRAISE FOR TOBIN BRONZE from Charlie Gallo is praise indeed. For he has been in the welding business 16 years. His long experience has taught him what to look for —and what to avoid—in welding rods.

Mr. Gallo believes in using good stock . . . thinks it pays him as well as his customers. Read his reasons for using Tobin Bronze . . . the original low melting point bronze rod. Uniform always!

Time-tried Tobin Bronze carries the name stamped every 12 inches in each rod. Look for this mark . . . don't gamble on an unproved rod. Make certain you are getting the genuine product . . . *genuine* Tobin Bronze.

•

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ANACONDA WELDING RODS

stainless), high-cobalt steels, and various forms of high-speed steels, can be successfully welded to any class of backing ferrous metals such as an easy-to-work mild steel or a strong alloy steel, it is said.

Cladding of any thickness can be applied, also the cladding may be on one or more surfaces or located in the corner, as is often desirable in cutting tools. Duo-Metals can be furnished where the facing, cladding or core metal can be any one of the alloy steels, or the process can be used in conjunction with non-ferrous metals such as nickel or nickel alloys. As long as the cladding ferrous or non-ferrous metal will remain solid and in workable condition at the diffusion temperature, such metal may be welded to a backing metal by the Duo process.

Trade Literature

"Wilson" welding electrodes, their physical properties, applications, and welding procedure, form the subject-matter of an interesting catalog issued by the Wilson Welder & Metals Co., Wilson Building, North Bergen, N. J. Besides many clear and interesting illustrations, this catalog also contains tables giving the chemical analyses of these electrodes, applications of each electrode, amperes and arc voltages recommended for the various types and sizes, also weights and sizes, and amount of metal deposited for various types of joints.

A folder on gloves, overalls and work clothes having a protective surface, for industrial use, has been issued by Safetex, Inc., 12 West 21st St., New York, N. Y. Protection against heat, cold, wind or chemicals is said to be imparted by the Safetex process, which is applied only to the exterior of the fabric, leaving the interior or body side unchanged and as comfortable as originally.

A booklet on National Shelby seamless steel mechanical tubing is being distributed by Williams & Co., 901 Pennsylvania Ave., Pittsburgh, Pa. Information is given to aid in ordering, and tables of weights, dimensions, chemical analysis, physical properties, and dimensional tolerances, are included. Gauge equivalents and decimal equivalents are also given in tabular form.

Equipment for moving, stacking and storing articles is shown and described in a folder issued by the Lewis-Shepard Co., Watertown, Mass. Skid platforms of various types, stock boxes, floor trucks, lift trucks, stackers, portable elevators, and storage racks are among the equipment described. The all-arc-welded construction is featured.

"The many profitable uses of the new 40-volt 'Simplified' arc welding" is the title of a new 40-page booklet issued by The Hobart Brothers Co., Box U-95, Troy, Ohio. Many interesting arc-welding jobs are described and illustrated, equipment and accessories are described, and the features of Hobart welders are pointed out.

The "Superior Emergency Burning Outfit" is described in a folder issued by the Superior Air Products Co., 132 Malvern St., Newark, N. J. The equipment consists of oxygen and acetylene tanks and regulators, cutting torch, 50 ft. of hose, goggles, gloves, wrenches and a flint lighter, all enclosed in a metal box.

"Amsco" nickel-manganese-steel welding rod is the subject of Bulletin No. 10, recently published by the American Manganese Steel Co., Chicago Heights, Ill. This bulletin shows several applications of this rod, lists some typical uses, and quotes reports from users. Directions for welding are also given.

General specifications on Lincoln engine-driven welders of 200-ampere NEMA rating, are given in Bulletin No. 309, while Bulletin No. 310 gives specifications for the 300-ampere models. Both of these bulletins are available from The Lincoln Electric Co., Dept. CC-162, Cleveland, Ohio.

The "Airco" portable tensile and bend testing machine is illustrated and described in a folder issued by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y. Data are given to simplify the computation of tensile strength, and complete operating instructions are included.

"Una" welding rods, arc welders, and welding head are listed in a new catalog, No. 146, just issued by Una Welding, Inc., Cleveland, Ohio. Information on the various rods is condensed into a table, which allows a quick selection of the proper rod for the work at hand.

Details for building girders from plates and beams, using welding, are given in Plate 51, of Studies in Structural Arc Welding, recently published by The Lincoln Electric Co., Dept. CC-162, Cleveland, Ohio. A table lists the properties of arc-welded girders.

The National Cylinder Gas Co., 2:5 W. Wacker Drive, Chicago, Ill., are announcing in their new welding supply price list, just released, a complete line of welding rods, electrodes and supplies, and also the new "Corta" torch cutting machine.

"Colmonoy" overlay metals are described and many applications shown in Bulletin No. 40, recently issued by Colmonoy, Inc., P. O. Box 977, Los Nietos, Calif. Information is also given on procedures for applying these materials.

"Amsco" hard-facing welding rods, their correct application, uses, and advantages, form the subject-matter of Bulletin No. 20, issued by the American Manganese Steel Co., Chicago Heights, Ill.

The advantages of their new 75-ampere welder for the welding of light-gauge metal, are brought out in a folder issued by The Hobart Brothers Co., Box U-95, Troy, Ohio.

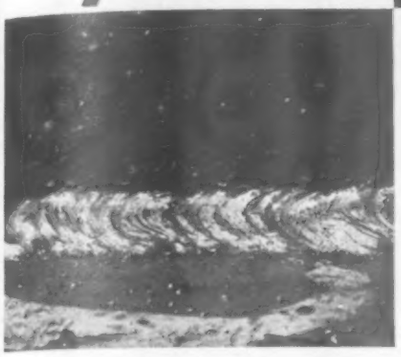
Decimal equivalents and B.W.G. gauges are given on a placard, 9x13½ in., for wall mounting, published by Williams & Co., 901 Pennsylvania Ave., Pittsburgh, Pa.

Commercial News

New Appointments by Republic Steel Corp.

The Republic Steel Corp. announces the appointment of John W. Carpenter as assistant manager of sales of the Sheet and Strip Division, and of J. P. ("Jack") Distler as manager of sales of the Wire Division. Mr. Carpenter was formerly district sales manager in the Cleveland, Ohio, territory for the Otis Steel Co., which position he held for 16 years. His headquarters will be at Youngstown, Ohio. Mr. Distler, whose headquarters will be at the company's Grand Crossing plant in Chicago, was formerly connected with the Keystone Steel & Wire Co., Peoria, Ill., as assistant sales manager and later as general manager of sales, and during the past two years he served on the Commercial Committee of the American Iron & Steel Institute. He succeeds R. W. Hull, whose duties as assistant manager of

Two SATISFACTORY WELDS ..but the weld made on the manipulator cost 1/5 as much as the other . . .



This fillet weld was made with 5/32" dia. shielded arc welding rod with 150 amperes at rate of *1.40* lbs. per hour.

The same job welded on the Manipulator with 5/16" dia. shielded arc welding rod with 350 amperes at rate of *7.04* lbs. per hour.

Welding on the Manipulator Saves Labor and improves the appearance of the job

Manipulators built to handle any job up to 100 tons

Write for an Estimate on Your Job

United bulletin "Management of Welding Costs" will be gladly sent on request

UNITED

ENGINEERING *and* FOUNDRY COMPANY

PITTSBURGH — PENNSYLVANIA

New Steel Sales Co. Office and Warehouse in St. Louis.

sales for all Republic products in the Chicago district will now receive his entire time.

Frank Liebich has been appointed by the Harnischfeger Corp. as district manager in charge of the company's operations in the Detroit area. He will have charge of the company's complete line of products, and will maintain headquarters in Detroit. Since entering the Harnischfeger Industrial Sales Division in 1924, Mr. Liebich has handled several of the country's largest installations of overhead traveling cranes, and recently has been located at the company's Chicago office.

The Wilson Welder & Metals Co. have announced the appointment of A. M. Castle & Co. as exclusive distributors of Wilson shielded-arc electrodes in the Chicago territory, including Iowa, Wisconsin, northern Illinois, northern Indiana and western Michigan. A. M. Castle & Co. will also distribute Wilson shielded-arc electrodes on a non-exclusive basis in the Pacific Coast states of Washington, Oregon and California.

Miles C. Smith, widely known in the hard-facing industry, recently became connected with Colmonoy, Inc., of Los Nietos, Calif., as sales manager. Mr. Smith has been active in the development and sale of hard metals over a period of many years, and was for a number of years connected with the Stoody Co. Many articles by him have appeared in technical and trade publications.

The Machinery & Welder Corp. has opened an office and warehouse in the Tri-City area, at 729 Third Ave., Moline, Ill. H. C. Kelsey, formerly of the company's Chicago office, has been appointed district manager with headquarters at the Moline office. In addition to Moline, the operations of this company now embrace Chicago, Milwaukee, Kansas City and St. Louis, says F. P. Kohlbry, president.

Carl C. Joys, Jr., has been elected a vice-president of the A. O. Smith Corp., Milwaukee, Wis. Mr. Joys has been connected with the company since 1924, first as manager of sales, and later as director of sales of the Oil & Gas Products Division and all other products aside from the Automotive Division. He will continue this work in his new position. He has been a director of the company since 1927.

The Stulz-Sickles Co., 134 Lafayette St., Newark, N. J., have appointed the following distributors for the sale of "Manganal" welding electrodes, applicator bars and wedge bars: The Galigher Co., 228-232 S.W. Temple St., Salt Lake City, Utah; Shadbolt & Boyd Co., 533 N. Plankinton Ave., Milwaukee, Wis.; and Central Welding & Machine Works, Muskogee, Okla.

A new company headed by John Gladden Lincoln as president and Homer Meaner as vice-president, both formerly with The Lincoln Electric Co., is reported as having taken a lease on a plant at 3005 East 55th St., Cleveland, Ohio, for a term of five years. The lessee will do contract, structural, pipeline, tank and machinery-base welding and steel fabricating.

A substantial interest in the Spencer Lens Co., of Buffalo, N. Y., has been acquired by the American Optical Co., but it is announced that the business of the former company will continue to be operated under the same name, with policies and personnel as at present, and with executive offices and manufacturing plant remaining at Buffalo.

David J. Champion, president of the Champion Rivet Co., Cleveland, Ohio, died on Sept. 10th, a few hours after having suffered a stroke. He was 74 years old. He organized the Champion company in 1895, becoming vice-president and general manager. His company is credited with having introduced the use of steel rivets.

The offices of the Taunton-New Bedford Division of Revere Copper and Brass Incorporated have been moved from Taunton, Mass., to New Bedford, Mass., where the company's principal New England mill is located. Mill operations will be continued, however, in Taunton and a warehouse also will be maintained there.

The demand for larger capacity has resulted in the construction of a new building to house the Hoist Division of the Harnischfeger Corp. at Milwaukee, Wis., which will be used exclusively in the manufacture of P&H-Milwaukee electric hoists. The new and modern plant is expected to be ready for occupancy about Sept. 15th.

At a recent meeting of the Board of Directors of the Thomas Welding Laboratories, 15120 Woodward Ave., Detroit, Mich., John D. Gordon was elected president to succeed Walter J. Thomas, who is no longer connected with the company. All the other officers remain the same as heretofore.

The Air Reduction Sales Co. is building a plant at 31st St. and Homan Ave. in Chicago, Ill., for the manufacture of oxygen and for housing their general offices. The new plant will have about 50% greater oxygen-generating capacity than the 22nd St. plant, which will be discontinued when the new plant is in operation.

The address of the Gil V. Dye Co., who are seeking a connection with some manufacturer of welding rods and of supplies on a representation basis, was incorrectly given in the August issue of *The Welding Engineer* as Houston, Texas. The company should be addressed at Box 821, Dallas, Texas.

Handy & Harman are building a new plant in Toronto, Canada, located at 141 John St., to be operated by their subsidiary, Handy & Harman of Canada, Ltd. The new plant will be equipped to carry on all operations now performed at the main plant in Bridgeport, Conn.

Fansteel Metallurgical Corp. is the new corporate name of the Fansteel Products Co., Inc., of North Chicago, Ill. The change in name does not imply any change in corporate structure or in organization, the company says.

The K. O. Lee & Son Co., of Aberdeen, S. D., are opening a branch office and store at 337 S. Western Ave., Chicago, Ill., where the company's line of shop equipment, including a.c. welders, will be handled.

The Steel Sales Co., 129 S. Jefferson St., Chicago, Ill., has opened an office and warehouse in St. Louis, Mo., at 4067 Park Ave., a view of which is shown on this page. The new office is in charge of R. R. Seding.

The Republic Steel Corp. has opened a new sales office at 622 Dwight Building, Kansas City, Mo., which will be in charge of Robert L. Pierce, of the St. Louis district sales office.

Notes From the Field

H. Joor, welding shop owner of Escondido, Calif., recently purchased a vacant lot at 302 E. Ohio St., which is across the street from his old location, and has erected a new 36x70-ft. shop building, which affords added working space and convenience. Mr. Joor introduced electric welding in Escondido some three years ago, and has built up a thriving business. Escondido is in the center of a large grape, avacado, and citrus fruit district in Southern California, which provides a great deal of irrigating-pipeline work as well as general agricultural repair work.

Harry E. Stitt, consulting engineer of The Austin Co., Cleveland, Ohio, died on Aug. 23rd, after a long-standing stomach ailment. He is credited with having originated the principle of standardized unit construction for modern industrial buildings, which idea was applied in hundreds of plants erected by The Austin Co. between 1914 and 1935, under his engineering direction. During this period he also pioneered in the application of welding to industrial construction and was largely instrumental in establishing a widespread preference for welded structures.

Jake Underwood, of the Electric Cutting & Welding Co., Bell, Calif., is planning a program for the construction of dry and wet placer gold-mining equipment. Being an experienced welder, Mr. Underwood sees the opportunity for great improvement by the use of welding in the construction of mining equipment and machinery now in use. Mr. Underwood is associated with a well-known mining engineer in the work, who is developing the idea in connection with geophysics.

A complete oxyacetylene-cutting outfit, including acetylene and oxygen tanks, mouldy with age and evidently bank robbers' "accessories," were recently found in a tunnel dug under the Farmers' & Merchants' Bank, of Watts, Calif. Evidently the bank-robbery plot was abandoned for some reason, as no entrance to the bank had been thus effected, and the oxyacetylene outfit was discovered only by accident while repairs were being made in the floor of the bank.

The McClintic-Marshall Corp., of Pittsburgh, Pa., has received a contract for a welded steel coal carbonizer, cylindrical in shape. It is 8 ft. in diameter and 126 ft. 10 in. long and will be manufactured at the Leetsdale works. The coal carbonizer will be used at the Champion, Pa., plant of the Pittsburgh Coal Co. in connection with the manufacture of low-temperature-distillation coke.

J. K. Long, of Long Beach, Calif., recently opened a new welding shop at 338 East 4th St., featuring general job welding and also specializing in welded steel reinforcing work on school structures. Mr. Long is certified by the State for this type of work and has handled several jobs for the local schools since the earthquake in 1933. The new shop is known as Long's Welding Works.

Robert T. Brooks, who has been identified with the structural-steel industry in New York for the past 30 years, has been designated executive vice-president of the American Institute of Steel Construction, which office was recently created by a vote of the Board of Directors, to be confirmed at the annual convention of the Institute, to be held in October. Mr. Brooks has been treasurer of the Institute for the past four years.

Eighty-six hundred tons of 22-in. welded steel pipe will be used in the early construction of a 46-mile gas line to extend south from San Francisco to the meter station of the Pacific Gas & Electric Co. Welding will also be employed in the laying of this line, which is scheduled for completion by Dec. 1st. The pipe contract was awarded to the Western Pipe & Steel Co.

An explosion caused by improper care in the use of an oxyacetylene torch caused the death of two men recently during the construction of a fermenting tank in the new plant of the Aztec Brewing Co., at San Diego, Calif. The explosion, which occurred during the waterproofing of the beer vat, was caused by the torch igniting escaping ammonia gas.

Lemon & Bradley, pipeline contractors of Tulsa, Okla., have been awarded a contract for the laying of an all-arc-welded 8-in. oil line for the Stanolind Pipe Line Co., of Tulsa. Twenty miles of the line will be in Pontotoc County near Ada, and the remaining eight miles will be between Drumright and Healdton.

A very attractive line of super-streamlined auto trailers for camping and touring is being turned out by the Masterbilt Trailer Works, at 3288 Fletcher Drive, Los Angeles, Calif. Much welding is used in their construction.

Work has been started on a project which will employ a large crew of weld-

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Safest Source for WELDING ROD

● **Change—improvement and better welding practice continues to characterize the welding industry. Now, especially engineered rods are helping to speed up work and at the same time give better results. Alert shops are continually checking, testing and keeping abreast of the newer developments. Our own engineers have developed rods that we know are outstanding for quality production. These rods have been especially designed for particular applications. And the wide range of Ryerson rods covers the entire field of welding.**

Have you tried the newer Ryerson rods? We would like to have you test them in your own shop—and let their performance tell the story. We will be glad to furnish samples. Address the nearest plant.

23 TYPES TO CHOOSE FROM

ELECTRIC RODS

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
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Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Ryerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

Bulletin No. 56, sent on request

JOSEPH T. RYERSON & SON, INC.

Chicago, Milwaukee, Philadelphia, Cleveland, Cincinnati, St. Louis, Buffalo, Detroit, Boston, Jersey City

ers by the Wilshire Oil Co. of Los Angeles, Calif. The job comprises the construction of a new combination straight-run and cracking process oil refinery at Norwalk, Calif. The project is scheduled for completion by Feb. 1st, and will cost approximately $2,000,000.

The Wright Oil Tool Co., specializing in welding, hard-facing and oil-well-digging-bit service, recently opened for business at 5716 Soto St., in Huntington Park, Calif. J. C. Wright, owner, was formerly president of the Globe Tool Co., of Los Nietos. J. E. Barringer, also formerly associated with the Globe Tool Co., is shop superintendent.

A combined electric-welded and Dresser-coupled steel water line, 23 miles long and of 30-in.-diameter pipe, will be constructed under a PWA contract by Williams Brothers, contractors of Tulsa, Okla., for the city of Ft. Smith, Ark. The welding on this job will be handled by H. C. Price, of Bartlesville, Okla.

A demonstration of arc welding will be given by Donald B. Harris, of the Scully Steel Products Co., distributors of Una equipment, before a group of Chicago welders on the evening of October 1st, at the Welders' Information Center, 741 West 70th St., Chicago, Ill.

The United States Army Engineers office of the Louisville, Ky., district will open bids late in September for the construction of two screw boats with welded steel hulls. They will be 31 ft. long, 7.6 ft. wide and 2.6 ft. deep and are to be equipped with 60-hp. full-Deisel engines.

E. O. Massa, who until a short time ago operated the Pacific Welding Works, in Hynes, Calif., has opened a shop under the same name at Cherry and South Sts., in North Long Beach.

Through advertising and other methods of promotion, their business in the welding of cast-iron boiler sections has increased approximately 20% over last year, William Schweitzer, president of Schweitzer Bros. Co., Inc., 442 E. Front St., Cincinnati, O., reports.

Dunny's Welding Shop, 13 Hughes St., Youngstown, Ohio, has been doing a thriving business in making repairs to contractors' equipment, trucks, tractors, and trailers.

It is reported that the United States Army Engineer's office in Pittsburgh, of which Major W. D. Styer is in charge, will soon ask for bids on four welded dump scows.

The American Institute of Steel Construction holds its 13th annual convention on Oct. 16th to 18th, at the Greenbrier Hotel, White Sulphur Springs, W. Va.

The Acme Welding Works, formerly located at 3406 E. Union Pacific Ave., Los Angeles, Calif., has been moved to 938 S. Alameda St.

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Count 8 words to line. Add 6 words for keyed address.

FOR SALE

WELDING HELMETS, GOGGLES AND GLASSES

Fiber helmets with No. 10 glass (for elec.), light weight and sturdy. Price	$5.75 ea.
2x4 glasses for above, any shade	1.60 ea.
Red fiber welding goggles (for gas welding)	1.35 ea.
Non-shatter grinding and chipping goggles	1.25 ea.

Highest quality, sent C.O.D., with the understanding that you may return within 10 days and we will refund full purchase price promptly. **Pavlik Bros., Kenilworth, Ill.**

Bargains—90-ampere gas-engine welder; 200-ampere Lincoln electric-drive welder; 300-ampere Hansen electric-drive welder; 400-ampere Una electric-drive welder; 600-ampere Hansen, generator only; several a.c. welders. Welding Engineering Co., Milwaukee, Wis.

For Sale or Trade—One 200-lb. Oxweld low-pressure generator and one 100-lb. Airco-Davis-Bournonville acetylene generator (in use about 8 months), for sale or trade in for a gasoline-driven arc welder. Johnstown Welding Co., 91 Poplar St., Johnstown, Pa.

Fly Ball Governors—Adapted to all makes of auto engines; belt driven, flat or V. Price, $6.50 prepaid. Satisfaction guaranteed. In ordering state style of belt. Wm. D. Alber, Beatrice, Nebr.

Bargain—Have three General Electric type MC automatic welding heads with control panels, in good condition, at attractive price. Address S-2, The Welding Engineer.

Bargains—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-951, Troy, Ohio.

WANTED TO BUY

Wanted—1,000 ft. or more of No. 00 flexible electric cable, either new or used. Price must be right. If used, state condition. Address S-4, The Welding Engineer.

HELP WANTED

Welding Technician—Thoroughly trained in chemical and metallurgical phases of the process. Experienced in selling cutting and welding equipment. Preferably man in early thirties. State age, education, and fully outline past experience. Good opportunity afforded by large manufacturer in Middle West. Address S-1, The Welding Engineer.

POSITIONS WANTED

Combination Service Sales Engineer—20 years' experience in the welding industry, both oxyacetylene and electric. Own a car. Willing to go anywhere, United States or foreign country. Have wide experience and a good reputation. Traveled as serviceman in sales promotion and direct sales. Experienced demonstrator and a thoroughly qualified contact man. Background of practical experience as well as theoretical knowledge. Honest, temperate. Have had exceptional success in dealing with difficult situations. A-1 references. Address S-3, The Welding Engineer.

EVER-KLEAR COVER LENS

Are guaranteed to give satisfaction, or your money cheerfully refunded. They absolutely will not pit. Molten metal cannot fuse to the surface. Guaranteed 300 actual welding hours. Do not be fooled by cheap substitutes of "non-pit" glass that only give a few hours of inferior service.

Size 2x4¼" for arc-welding shields, $2.40 per dozen.
Sizes 45 to 50 M.M., inclusive, for welding goggles, 35 cents per pair.

Dealers in Principal Cities

F. R. FAULK — **50 Penn Ave., Pittsburgh, Pa.**

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